THE PLANT DISEASE REPORTER

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PLANT DISEASE EPIDEMICS
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IDENTIFICATION SECTION

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PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

Horticultural Crops Research Branch — Plant Industry Station, Beltsville, Maryland

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GLADIOLUS VIRUS SURVEY IN OREGON IN 1954

Julius L. Heinis

Early in 1954 the nursery inspectors desired a further survey for gladiolus viruses in Oregon to obtain data for their cleanup program. The gladiolus industry in Oregon included 429 acres in 1953, and there is a considerable interest in growing virus-free corms.

Methods

By making inspections when most of the varieties were in bloom it was possible to survey for both foliar and floral virus symptoms simultaneously. Over 240 acres of gladiolus, of 25 growers, were surveyed. For the foliar viruses the percentage of virus-infected plants was determined by counting ten samples of ten plants each at random places in the field. For the flower viruses, which were less frequent, only the names of the varieties affected and the approximate amount of disease were recorded.

Description of the Viruses

From reports in the literature and discussions with Oregon State College specialists, it is clear that the virus situation in gladioli is complex. Often several strains or even different viruses may be responsible for a certain condition. For positive identification, mechanical transmissions to other hosts, comparison with other viruses on these hosts, cross protection tests, and analyses of the physical properties, are usually made. None of these techniques was available for this survey, and virus differentiation was entirely based on the expression of symptoms on gladioli in field conditions.

1. Cucumber Mosaic Virus: Cucumber mosaic in gladiolus expresses itself by chlorotic mottling which is most prominent on the outer leaves (Fig. 1). Typical cucumber mosaic virus symptoms are small squares between two veins of the gladiolus leaves. A wide range of symptom expressions exists. Severe cases can be recognized readily, because of the yellow appearance of the plants, while mild cases are often visible only if a leaf is held against the light.

2. Ringspot Virus: The typical ringspot symptoms may be expected on the central leaves. The rings are from one to three millimeters in diameter and usually chlorotic with a dark green center. Often cucumber mosaic virus and ringspot virus symptoms may be observed on the same plant. As with other diseases more research is needed to establish the identity of this condition (2).

3. Ring Pattern: The chlorotic rings are larger than in ringspot virus, of irregular shape, and enclose up to a half centimeter square of leaf area. Berkeley (1) reported this condition in 1953 and called it a strain of ringspot virus. In this survey chlorotic ring pattern was not found very frequently.

4. Yellow Bean Mosaic: This is a latent virus, which means that it is often present in plants without showing symptoms. Yellow bean mosaic probably is a component of many virus mixtures. To demonstrate this virus with certainty inoculations into herbaceous index plants, by mechanical means or by the insect vectors, are necessary.

5. White Streak on the Flowers: White streak can be seen only when the gladioli are in bloom. Plants with leaves showing cucumber mosaic virus symptoms often may produce a healthy flower spike, while some glads affected with white streak have leaves which show none or only a mild foliar virus. White streaks or white breaks in the flower petals are characteristic of this diseased condition (Fig. 2). These symptoms may also be seen in the bud stage. Usually the flower is distorted and smaller than usual. The reduction of the spikes to small stubby heads also may be associated with this virus.

6. Western Aster Yellows: Three plants were found with a green bud condition. The flowers did not open and the petals were green, and the leaves of the affected plants were yellow and brown. Palm and Young (3) described this disease in 1952.

FIGURE 1. Gladiolus showing a foliar virus of the cucumber mosaic virus type. Note the mottling on the outer leaves.

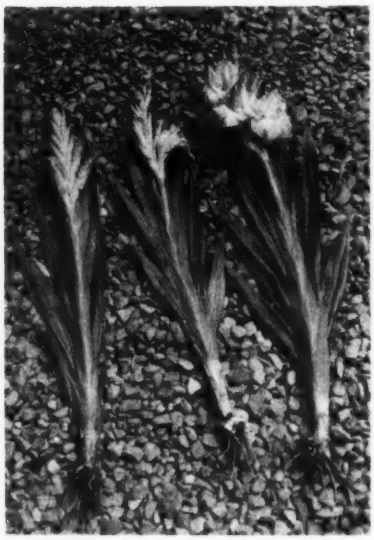

FIGURE 2. Gladiolus variety Heirloom with a flower virus. Note the short spikes and the white streaks or breaks in the flowers.

(Photographs by G. Morgan).

Results of the Survey

From the data recorded the average amount of foliar virus was found to be 21 percent. This amount, however, included mostly mild forms, and only about 1 percent of the plants with cucumber mosaic virus symptoms could be classed as severe.

Ringspot virus and cucumber mosaic virus were difficult to differentiate on the basis of field observations alone. As far as the cleanup program is concerned, to assemble them under the term foliar viruses seemed more practical. Yellow bean mosaic and the ring pattern condition also were classified in this group.

The flower viruses included white streak and western aster yellows. The percentage of white streak found in northern Oregon was low and restricted to a few varieties. Only two plants with white streak were found in southern Oregon and none in eastern Oregon.

Western aster yellows was seen on only three plants. Palm and Young reported that in 1951 they found up to 2 percent on one variety. Apparently roguing of affected plants has mar markedly reduced this disease.

Conclusions

For an effective cleanup program roguing of all plants showing white streak and western aster yellows is absolutely necessary. At the same time gladioli with severe cucumber mosaic virus and ringspot virus should be pulled out. By this procedure the percentage of virus infestation should gradually be reduced to a negligible amount.

The fact that so little white streak was found as compared to other years indicates that the cleanup program initiated by the State Department of Agriculture and followed by the growers already shows some results.

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OREGON STATE DEPARTMENT OF AGRICULTURE, DIVISION OF PLANT INDUSTRY, PLANT DISEASE SURVEY, SALEM, OREGON

CASSIA TORA, A LEGUMINOUS HOST OF TOBACCO ETCH VIRUS[1]

C. W. Anderson[2]

SUMMARY

Plants of Cassia tora are susceptible to systemic invasion by strains of tobacco etch virus and have been found infected under field conditions. Cassia plants are also susceptible to local infection by Potato Y and Blackeye cowpea mosaic viruses, but are immune to several other viruses. Cassia plants as well as Physalis peruviana plants can be used in immunological studies of tobacco etch virus. The advantages and disadvantages of Cassia plants in this respect are discussed.

In 1937, Brooks (2) reported that tobacco mosaic virus did not infect plants of Cassia tora L., but that a mosaic disease due to an unidentified virus was intertransmissible between pepper (Capsicum frutescens L.) and Cassia plants. Since 1950, the writer observed several cases of apparent association between mosaic of pepper and mosaic of Cassia plants in the field. The present study concerning a mosaic virus obtained from Cassia in 1953 indicates that tobacco etch virus was the causal agent. So far as known, this constitutes the first proof that etch virus can infect a leguminous host.

MATERIALS AND METHODS

The viruses used were: Cassia virus; Sanford pepper virus (a possible severe strain of potato virus Y similar to that recently reported (3) from tomatoes); tobacco mild etch virus supplied by Doolittle; tobacco severe etch virus supplied by Holmes; potato Y and alfalfa mosaic viruses supplied by McKinney; tobacco mosaic virus; southern cucumber mosaic virus; substrain of Marmor cucumeris phaseoli Holmes obtained from cowpea plants; and Blackeye cowpea mosaic virus (a probable strain of M. vignae Holmes). The carborundum method of mechanical inoculation was used exclusively.

RESULTS

Host Range -- The Cassia virus caused necrotic local lesions and systemic mottling, distortion, stunting, and necrotic patterns in Cassia plants. It induced essentially mosaic-type diseases in plants of Nicotiana tabacum L. (tobacco), N. glutinosa L., Lycopersicon esculentum L., Capsicum frutescens (California Wonder pepper), Physalis peruviana L., and P. pruinosa L. It caused the wilt reaction (4) of etch virus in Tabasco pepper (Capsicum frutescens) plants. It failed to infect plants of Phaseolus vulgaris L., Pisum sativum L., Vigna sinensis Endl., Cucumis sativus L., and Apium graveolens L.

One or both of the etch virus strains caused symptoms similar to those of the Cassia virus in the above host plants. Like the Cassia virus, severe etch virus induced dull gray, solid, necrotic local lesions within five to ten days in Cassia plants. The lesions tended to spread along the veins. The subsequent systemic symptoms of severe etch virus also consisted of mottle, stunting, distortion, and necrosis. The systemic necrotic patterns tended to appear as rings or to follow the veins. Mild etch virus caused no definite local lesions. Its systemic symptoms were similar to but milder than those of the severe etch and Cassia viruses. Severe etch virus more commonly induced local and etch symptoms on tobacco plants than either of the other viruses. Severe etch virus caused local lesions, leaf drop, and a severe chlorotic mosaic disease on plants of Physalis peruviana, as described by Holmes (5). The Cassia and mild etch viruses caused only mottle, stunting, and distortion on this host. All three viruses induced dull chlorosis, wilting, extreme stunting, and vein clearing on Tabasco pepper plants.

Immunological Studies -- Limited immunological studies between the two etch strains were undertaken in Cassia plants. Previously healthy Cassia plants developed 118 local lesions following inoculation with severe etch virus. Cassia plants previously infected by mild

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Table 1. Susceptibility of Cassia tora plants to ten viruses.

Virus	Results	
	Infection[a]	Recovery[b]
Cassia virus	5/6 LS	2/2 S
Tobacco etch: severe	10/11 LS	4/4 S
Tobacco etch: mild	7/9 L?S	4/4 S
Sanford pepper virus	0/4	0/4 E
Potato Y	4/10 L	0/6 S
Potato Y	4/10 L	6/6 L
Tobacco mosaic	0/10	0/4 S
Alfalfa mosaic	0/10	0/4 E
Southern cucumber mosaic	0/10	0/4 E
Marmor cucumeris phaseoli H. substrain	0/11	0/9 E
Blackeye cowpea mosaic	13/13 L	0/10 S
Blackeye cowpea mosaic	13/13 L	0/6 L

[a] Numerator = plants infected; denominator = plants inoculated (judged by symptom development). S = systemic symptoms induced; L = local symptoms induced; L? = questionable (faint, unclear) local symptoms induced.

[b] Numerator = plants infected; denominator = plants inoculated. S = recovery attempted from noninoculated plant parts; L = recovery attempted from inoculated plant parts; E = recovery attempted from entire plant. Recovery was attempted on equal numbers of tobacco and Tabasco pepper plants, except that: California Wonder pepper sometimes replaced Tabasco; two-thirds of the potato Y virus recovery attempts were made to tobacco, and one-third to pepper; two-thirds of the Marmor cucumeris phaseoli substrain recovery attempts were made on pepper; and the remaining third of the M. cucumeris phaseoli substrain recovery attempts and all those with Blackeye cowpea mosaic virus were made on Blackeye cowpea plants.

etch virus failed to show primary lesions attributable to a similar severe etch virus inoculation. However, necrotic patterns did develop on the severe etch virus-inoculated leaves of these plants. The patterns were attributed to the systemic symptoms of mild etch virus. When attempts were made to recover virus on Physalis peruviana plants, severe etch virus was recovered from the inoculated leaves of the previously healthy Cassia plants. Only mild etch virus was obtained from the severe etch-virus-inoculated leaves of the mild etch plants.

Similar immunological studies were undertaken in Physalis peruviana plants. The mild etch and Cassia viruses completely protected Physalis plants from severe etch virus. The Sanford pepper virus reduced the number of lesions induced in Physalis plants by severe etch virus but failed to prevent systemic invasion by the latter. Potato virus Y caused no symptoms in Physalis plants in limited tests.

Susceptibility of Cassia plants to Other Viruses -- Repeated attempts were made to transmit each of the ten viruses to Cassia tora plants (Table 1). Only the Cassia virus and the two etch strains induced systemic infection. Potato virus Y and Blackeye cowpea mosaic virus caused local lesions without systemic infection. Cassia seedlings were apparently immune to the remaining five viruses.

Potato virus Y lesions appeared as dull gray necrotic rings in about ten days. The rings enlarged (with necrosis spreading particularly along the veins) and the inoculated leaves became chlorotic. Blackeye cowpea mosaic virus lesions appeared as solid, relatively shiny, bluish or purplish-black spots in three to five days. Lesion enlargement and chlorosis of the inoculated leaves occurred with this virus as with the other two.

A peculiar mild mottle sometimes occurred spontaneously in the leaves of Cassia seedlings. This condition differed from those reported above, did not prove sap-transmissible in limited tests, and is probably of non-virus origin.

DISCUSSION AND CONCLUSIONS

The host range, symptoms, and immunological relationships of the Cassia virus indicate that it is a tobacco etch virus strain intermediate between those of severe and of mild etch. Bawden and Kassanis (1) reported that mild etch protects tobacco plants against invasion by severe etch virus, while severe etch virus replaces potato Y or Hyoscyamus 3 viruses. In the present study, the mild etch and Cassia viruses protected Physalis peruviana plants from invasion by tobacco severe etch virus; while the Sanford pepper virus reduced the number of local lesions caused by severe etch virus but failed to prevent systemic invasion by the latter. Therefore, the reactions among the two etch strains and the Cassia virus correspond to those expected (from the work of Bawden and Kassanis) for strains of etch virus; but the reaction between the Sanford pepper and the severe etch viruses does not. The Sanford virus also differed from the etch strains in causing a mosaic disease rather than a wilt reaction in Tabasco pepper plants and in failing to infect Cassia plants.

Holmes (5) recommended Physalis peruviana as a valuable plant for immunological studies concerning tobacco etch virus. Cassia plants may also be used for this purpose. Inasmuch as Cassia proved susceptible to all tested etch strains but immune to systemic invasion by several other viruses (some of which invade Physalis systemically), Cassia derives a special value. However, the systemic necrotic patterns of etch virus in Cassia seriously complicate the making of accurate lesion counts. Possibly, tests conducted under cooler environmental conditions would not encounter this difficulty.

Cassia seed should be scarified to insure satisfactory germination. The tobacco etch virus strains readily invaded Cassia plants systemically when young seedlings bearing only simple leaves, or simple leaves plus one to three compound leaves, were inoculated. Relatively old inoculated plants did not develop systemic symptoms within a supposedly sufficient period (15 to 21 days). Since the lesion-bearing inoculated leaves of such plants were dropped, it may be that dropping occurred before the virus entered the rest of the plant. An alternative explanation is that the incubation period required for the development of systemic symptoms in older plants is considerably longer than that required in young inoculated plants, and the old plants were not kept long enough. Field observations suggest that older plants can become infected. This might mean that aphids can induce systemic infection in plants of any age.

The importance of Cassia as a source of etch virus in the field is undetermined. Observations by the writer and the earlier report by Brooks (2) suggest that field infection may be fairly common in Florida. In north-central Florida, Cassia plants do oversummer the virus but cannot overwinter it, as they die. Oral discussions with others indicate that, farther south Cassia plants may survive the winter and prove a year-round source of etch virus.

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NEW RECORDS OF VIRUS DISEASES OF ORNAMENTAL PLANTS

Philip Brierley[1] and Floyd F. Smith[2]

In the course of investigations of virus diseases of ornamentals, new records included two new hosts and a new locality for the aster yellows virus, Georgia Easter lily as a new source of lily rosette virus, and a disease of Laburnum new to this country from which tobacco ringspot virus was isolated.

ASTER YELLOWS IN PANSY (VIOLA TRICOLOR L.) IN MARYLAND: Pansies used as bedding plants on the grounds of the Plant Industry Station, Beltsville, Maryland, showed yellows symptoms at flowering time, April, 1954. Vein-clearing and bright yellow chlorosis of leaves were prominent (Fig. 1.). Flowers were not streaked or distorted, but were smaller than normal ones. Among 2000 plants examined 44 affected ones were counted; incidence over the whole planting was estimated at only 1 to 2 percent, but appeared much higher because of the conspicuous yellowing of affected plants. The aster yellows virus was transmitted from such pansies to China aster by the vector Macrosteles fascifrons (Stal.). This is believed to be the first record of occurrence of aster yellows in pansy or in the family Violaceae. Hoppers were not found on the pansy plants in April; infection is believed to have occurred in the previous autumn, after the plants were transplanted from a greenhouse in September.

ASTER YELLOWS IN HYDRANGEA (HYDRANGEA MACROPHYLLA (THUNB.) DC.) IN OREGON: A single plant of the florists' hydrangea var. Charm showing vein-clearing in a young side shoot and proliferation of pistils into vegetative shoots (Fig. 2) was received from Oregon in May, 1954. The aster yellows virus was transmitted from this plant to China aster by Macrosteles fascifrons. High temperatures prevented determination of the strain of aster yellows virus involved. The affected plant declined steadily and died, indicating that this virus is lethal to hydrangea. This is believed to be the first record of aster yellows in hydrangea or in the family Saxifragaceae. The Oregon grower reported that only 2 of 15000 plants showed yellows symptoms, which were new to him. He had purchased dormant plants from California.

WESTERN ASTER YELLOWS IN GLADIOLUS IN KANSAS: In July, 1954, a commercial gladiolus grower in Kansas sent us 62 corms with the report that similar stock produced only thin weak shoots or failed to grow. He reported that planting stock from the West Coast when irrigated had produced an apparently good crop of galdiolus in 1953. The disease was not recognized until the 1954 season when large numbers of the gladiolus produced only thin multiple sprouts or failed to grow. When planted in a greenhouse all sample corms developed multiple sprouts, only 17 making sufficient growth to emerge above the soil. Thirty thin weak sprouts developed from a single corm. The symptoms agreed with those reported previously in gladiolus from Oregon in 1952 (5) and shown to be caused by western aster yellows virus (6). This is the second instance known to us of commercial loss from aster yellows in gladiolus and the first record of such loss in Kansas.

LILY ROSETTE IN EASTER LILY IN A WEST VIRGINIA GREENHOUSE: Easter lilies (Lilium longiflorum Thunb.) of the Croft variety with symptoms suggestive of lily rosette were brought to us by a West Virginia forcer in March, 1954. The vector of lily rosette virus, Aphis gossypii Glover, was present on the lilies when recieved, and in an experiment it transmitted this virus to Easter lily seedlings. The grower stated that 150 of 800 plants of the Croft variety developed rosette and were unsalable. On visiting the West Virginia greenhouse we found Croft lilies with typical rosette symptoms and Georgia Easter lilies with atypical effects. It is believed that the Georgia variety introduced the virus and the vector and that both moved later to the Croft variety. In earlier tests experimental infection of the Georgia variety with rosette virus induced characteristic rosetting in the year of infection, but only dull yellowing and irregular twisting of leaves appeared in the year following. An effort was made to trace the origin of the Georgia variety in question. No rosette was found in five plantings of the

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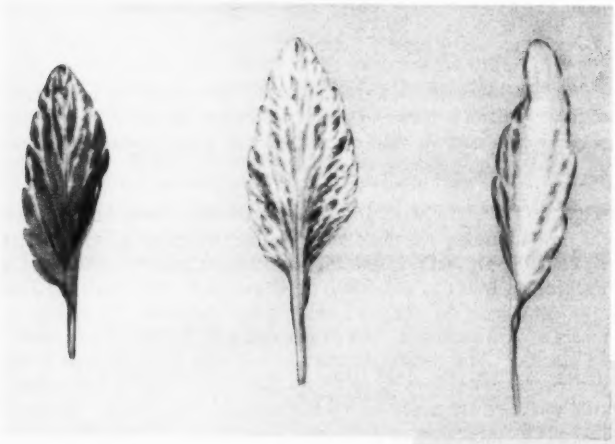

FIGURE 1. Aster yellows symptoms in pansy.

FIGURE 2. Aster yellows symptoms in hydrangea. Note green sepals, apparently normal stamens, and pistil proliferated to form a green shoot furnished with two leaves and a bud.

Georgia lily in Georgia, including the supposed source of the infected stock. Presumably some producer of the Georgia variety is harboring the rosette virus and is unwittingly supplying it to greenhouse forcers. The mild symptoms expressed in Georgia lilies in the second and later seasons make thorough roguing difficult.

TOBACCO RINGSPOT IN LABURNUM ALPINUM IN MARYLAND: In June, 1954, two plants of L. watereri Dipp. (L. vossii Hort.) and one of L. alpinum (Mill.) Bercht. & Presl were received from a Maryland nursery. Leaves of L. watereri showed a narrow yellowish vein-clearing pattern; those of L. alpinum displayed a broader and more conspicuous vein-banding pattern similar to that illustrated in Atanasoff's Fig. 5 (1), as variegation in a leaf of L. vulgare Bercht. & Presl (now called L. anagyroides Med.), and also similar to that of mosaic in L. alpinum, Katwijk's Fig. 1, right (4).

Inoculations from leaves of L. alpinum by the Yarwood (7) method produced reactions of a ringspot type in tobacco, cucumber, snapdragon, and bean. The virus thus detected proved to be a mild strain of the tobacco ringspot virus, similar to mild strains common in gladiolus.

It proved infectious to gladiolus seedlings, producing systemic sparse yellow flecking after 17 days. Although the Laburnum strain produced much milder symptoms in various test species than the type strain of tobacco ringspot virus, ATC #98 supplied by H. H. McKinney, it fully protected tobacco plants against superinfection by this type strain.

The susceptibility of L. alpinum implies that the virus is not Marmor laburni Holmes (3), the Laburnum-mosaic virus, which is based on Baur's (2) work, for Baur reported this species immune. Moreover Baur's source material bore the names Laburnum vulgare chrysophyllum (golden leaf) and L. vulgare fol. aureis (golden leafed), which are not descriptive of the symptoms in L. alpinum in Maryland. The name Laburnum vein-mosaic is therefore proposed for the disease from which tobacco ringspot virus was isolated. No evidence is available that this virus causes the Laburnum vein-mosaic.

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HORTICULTURAL CROPS RESEARCH BRANCH & ENTOMOLOGY RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE, BELTSVILLE, MARYLAND

THE ASSOCIATION OF DIAPORTHE PHASEOLORUM VAR. SOJAE WITH ROOT AND BASAL STEM ROT OF SOYBEAN

J. W. Gerdemann

ABSTRACT

The pod and stem blight fungus, Diaporthe phaseolorum var. sojae, was found associated with root and basal stem rot of soybean in four Illinois fields. When soybeans were planted in soil infested with this organism, lesions developed on cotyledons, lower hyocotyls, and upper taproots. Several seedlings were killed and others stunted. One week after emergence, lesions made no further development. In the spring of 1954 the pod and stem blight fungus was found in a viable condition on old soybean stems found buried in the soil of a field that had not been in soybeans since 1951. The possibility is suggested that infection may sometimes occur on the root or basal stem of soybeans, remain semi-dormant through the growing season, and spread through the plant as it matures.

Soybean plants with root and basal stem rot were collected during August, 1953, in 12 widely scattered fields in Illinois. A total of 128 plants were selected for plating. Roots and stems were washed, surface sterilized with 1:1000 mercuric chloride and again washed with water. Bits of the upper taproot or basal stem were plated on acidified potato dextrose agar. Fungi isolated are listed in Table 1. It should be emphasized that frequent isolation of a fungus does not necessarily indicate pathogenicity. It should also be borne in mind that the method of isolation probably had a selective effect in determining the species isolated.

Table 1. Fungi isolated from 128 soybean plants with root and basal stem rot. Collected in 12 widely scattered Illinois fields. August, 1953.

Species	Number of fields	Number of times isolated
Fusarium oxysporum	12	54
Gliocladium sp.	8	40
Alternaria sp.	6	25
Diaporthe phaseolorum var. sojae	4	14
Leptodiscus terrestris	4	13
Sclerotium bataticola	3	11
Fusarium solani	4	7
Rhizoctonia solani	3	4
Fusarium moniliforme	2	4
Penicillium spp.	4	4
Aspergillus sp.	1	3
Trichoderma sp.	1	1
Unidentified	4	9

As far as the writer is aware this is the first record of the association of Diaporthe phaseolorum var. sojae[1] with root and basal stem rot. Lehman (1) regarded the pod and stem blight fungus as a virulent pathogen; however, other workers (2, 3) considered it to be a weak pathogen or a saprophyte that invades fully mature plants, or plants killed by other fungi.

A small scale pathogenicity test was made with one isolate of Diaporthe phaseolorum var. sojae. Two 6-inch pots were filled with steam sterile soil and 16 seeds of Hawkeye soybeans were sown in each. The mycelial growth from five- to six-day old agar slant cultures was re-

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[1] Cultures did not produce perithecia. However, the pycnidial stage was produced and appeared identical with that described for Diaporthe phaseolorum var. sojae. The isolates werealso quite similar in cultural appearances to an isolate of Diaporthe phaseolorum var. sojae from Dr. Kirk L. Athow, Purdue University, Lafayette, Indiana.

moved and mixed with water in a Waring blendor. This suspension was poured over the seed before covering with soil. Two check pots were also seeded.

Brown lesions developed on cotyledons of seedlings growing in infested soil. Infected cotyledons became yellow and dropped off prematurely. Brownish-red lesions developed on the lower hypocotyl and upper taproot near the soil line, resulting in the death of three seedlings. About one week after emergence the lesions stopped developing and plants began to recover. One month after planting, plants in infected pots were shorter than plants in check pots. There was a considerable range in disease severity, from plants that were completely girdled at the base and killed or severely stunted, to plants nearly free from disease. A few small rootlets were killed on some plants, but most roots remained healthy.

In May of 1954, soybean stems were collected from the soil of a field in which soybeans were last grown in 1951. This field was seeded to red clover in 1952 and the clover was still in the field in 1954. Partially decomposed soybean stems obtained from above and below ground were covered with black pycnidia of the pod and stem blight fungus. In a moist chamber abundant production of spores demonstrated that this fungus is capable of surviving on soybean stems in the soil for long periods.

The possibility is suggested that the pod and stem blight organism surviving on old soybean stems in the soil may infect the base of the plant, remain semi-dormant during the growing season and then spread throughout the plant as it matures.

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DEPARTMENT OF AGRONOMY, UNIVERSITY OF ILLINOIS, URBANA, ILLINOIS

THE EFFECT OF LUPINE SEED TREATMENT BY CHLORANIL[1] ON PLANT GROWTH, NODULATION, AND NITROGEN FIXATION[2]

Harvey W. Rankin

SUMMARY

Lupine seed treatment with chloranil (tetrachloro-para-benzoquinone) did not increase seedling stand consistently though it did reduce root-rot to some extent. The Rhizobium inoculum was killed or inactivated to a significant extent by the treatment and this was directly correlated with reduced nodulation, nitrogen fixation, and growth of plants grown from treated seed. By March 16 plants grown from untreated seed produced 44 pounds more nitrogen per acre than plants grown from treated seed.

Blue lupine has become the most important winter legume in the lower Coastal Plain of the Southeast. Under normal conditions it makes a heavy growth and if it is turned under at the right time it produces an abundance of cheap nitrogen for the crops following it in rotation. For best growth, seed inoculation is essential (13).

Lupine is subject to several diseases. Some of these, such as anthracnose caused by the fungus Glomerella cingulata (Ston.) Spauld. & Schrenck, and brown spot caused by Ceratophorum setosum Kirch. are seed-borne (4, 15, 16). Other diseases, such as Rhizoctonia, Fusarium and Sclerotium rolfsii root rots, and Sclerotinia and Botrytis blights survive from year to year on plant debris in the soil. These diseases have complicated the lupine problems. They dictate crop rotation, which makes yearly inoculation more important. They also make it highly desirable that a seed treatment be worked out which would disinfect the seed and also give some measure of protection to the seedlings.

Treatment of legume seeds with disinfectants is relatively new, and most of the reports on it have been published within the past five years. Johnson (8) and Johnson and Kilpatrick (9) reported increased stands and yields from treating soybean seeds with Spergon. Anderson (1) obtained very good control of anthracnose of beans with a slurry treatment of Vancide 51. Boosalis (2) found that treating soybean seeds with Ceresan M or Spergon reduced infections by Rhizoctonia solani considerably. The Du Pont Company in their 1953 report (5) show increased stands in 49 out of 64 tests where legume seeds were treated with Arasan. Some investigators, however, have found that legume seed treatment by disinfectants either reduced yields or had little effect on stand or yield (3, 14); others found that results obtained by such treatments depended on several conditioning factors such as Rhizobium population in a given soil (10, 11), soil types (6, 7, 12), and varying environmental conditions (6).

This investigation arose from lupine seed treatment tests at the Georgia Coastal Plain Experiment Station. The results closely paralleled the findings of Decker (3) who stated that a small but significant increase in stand was usually obtained from seed treatment under field plot conditions. At the Tifton Station chloranil (Spergon) consistently stood at or near the head of the list in these tests. On the basis of Decker's work and work done at Tifton and Experiment, Georgia, it was decided to run an extensive field test of one acre, using Spergon as the only seed treating material. The tests were run for three consecutive years.

Materials and Methods

Bitter blue lupine seed was used for the 1949-51 plantings and sweet yellow lupine in 1951-52. The change from blue to yellow lupine was made because it was found that nodulation determinations could be made much more accurately with yellow than with blue lupine. In each case 100 pounds of seed were used per acre, and half of this was treated with Spergon four or five days before planting at the rate of four ounces per 100 pounds of seed. All of the seed were of good quality, free from anthracnose and brown spot, one year old and of approved moisture content. A new supply of Spergon was obtained for treatment each year. The nodulation inocu-

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[1] Spergon, Trade name, U. S. Rubber.

[2] Contribution of the Department of Plant Pathology, Coastal Plain Experiment Station, Tifton, Georgia. Published with the approval of the Resident Director as Journal Series Paper Number 30.

The author wishes to thank J. L. Stephens and W. H. Marchant for cooperation that made this work possible.

Table 1. Lupine seed treatment with chloranil. Stand counts for the years 1949-50, 1950-51, and 1951-52.

Treatment	Number of plants		
	1949-1950[a]		
	Dec. 2 1949	Jan. 11 1950	Feb. 18 1950
Seed treated	1329	1240	1137
Seed untreated	1385	1436	1391
	1950-1951[a]		
		Jan. 26 1951	
Seed treated		634	
Seed untreated		434	
	1951-1952[b]		
	Dec. 20 1951	Jan. 29 1952	Feb. 19 1952
Seed treated	2596	2399	2446
Seed untreated	2331	2346	2195

[a] Rows 30 feet long, 24 rows per treatment.

[b] Rows 18.5 feet long, 60 rows per treatment. (Fig. 1).

lum was fresh and from a recognized producer. All seed were inoculated at double the recommended rate immediately before planting. All planting was done with a grain drill set to put down 100 pounds of seed per acre. Untreated-inoculated seed was planted first, followed by the treated-inoculated seed. The treated and untreated seed plots were alternated.

The planting in 1949 was not made for the purpose of making a study of nodulation as it affects nitrogen fixation and growth. Approximately three months after the test was planted, a very striking difference was noted in appearance between the plots planted with treated seed and those with untreated seed. The plots planted with untreated seed were of a dark green color and showed good growth while the plots from treated seed were pale green and showed less growth. At first it was thought that the difference might be due to root infections, but this was shown not to be the cause. On January 31, 1950, 400 plants from each type plot were dug and divided into categories on the basis of the number and average size of nodules per plant. No weights were made on a category basis. The process was repeated on February 24, 1950. The experiment was repeated in the 1950-51 season, but the plants were completely killed by cold during the last week of November. The plots were replanted the first week of December, but cold again killed most of the plants.

The experiments were repeated in the fall of 1951, using sweet yellow lupine and following the same planting procedure as in 1949-50. Stand counts were made on two dates and in each case the plants in two drill rows, of a standard length, were counted in each plot. There were 30 replicates of each type plot. On February 26 and March 26 nodulation determinations were made. Three hundred plants grown from treated seed and a like number grown from untreated seed were dug at random. Nodulation standards were determined and category standards were set up. The total numbers and weights of plants from each seed treatment were determined by category and from this average weights per plant were made. Samples of three pounds each from each category were placed in cloth bags and thoroughly dried, after which nitrogen deter-

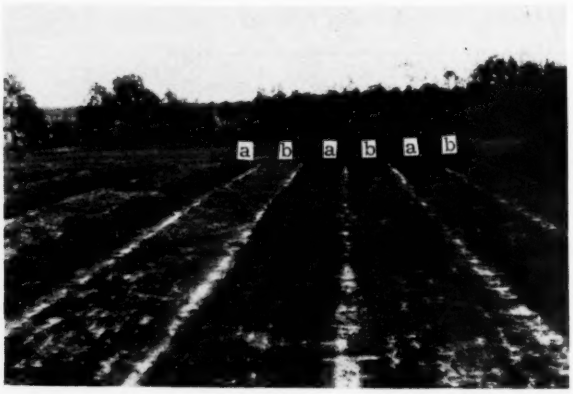

FIGURE 1.
Field plots of sweet yellow lupine grown from:
A -- untreated seed
B -- treated seed

FIGURE 2.
Sweet yellow lupine nodulation standards used in classifying plants in categories:

0 = no nodulation, to
5 = maximum nodulation.
Note correlation between nodulation and growth.

Table 2. Nodulation of plants grown from chloranil treated and untreated lupine seed; 1949-50 season.

Nodulation category[a]	Percent of plants in category			
	January 31		February 24	
	Treated seed	Untreated seed	Treated seed	Untreated seed
0	45.5	11.3	7.6	3.3
1	25.0	30.2	38.2	15.0
2	17.3	20.1	21.4	9.2
3	6.5	13.7	16.0	21.7
4	1.1	5.9	3.1	9.2
5	4.5	18.8	13.7	41.7

[a] 0 = No nodulation; 5 = maximum nodulation.

Table 3. Correlation of degree of nodulation of lupine plants with chloranil seed treatment, average plant weight, and nitrogen content. Data of February 26, 1952.

Nodulation category[a]	Percent plants from seed		Average weight per plant (grams)	Percent nitrogen (dry weight)
	Treated	Untreated		
0	42.5	4.5	16.08	2.71
1	8.9	6.9	16.8	2.89
2	18.8	26.7	17.7	3.97
3	15.6	30.4	26.6	3.82
4	11.6	24.4	43.3	3.95
5	2.7	12.1	66.6	3.95

[a] 0 = No nodulation; 5 = maximum nodulation. (Fig. 2)

Table 4. Correlation of degree of nodulation of lupine plants with chloranil seed treatment, average plant weight, and nitrogen content. Data of March 26, 1952.

Nodulation category[a]	Percent plants from seed		Average weight per plant (grams)	Percent nitrogen (dry weight)
	Treated	Untreated		
0	22.0	4.0	49.7	2.61
1	20.0	9.5	47.3	2.42
2	14.0	15.0	61.7	2.87
3	20.0	27.5	72.0	3.31
4	15.5	22.0	134.4	3.07
5	8.0	21.5	251.1	3.30

[a] 0 = No nodulation; 5 = maximum nodulation. (Fig. 2).

minations were made.

Results

Data were obtained in 1949-50 and in 1951-52 from plants grown from treated-inoculated seed and from untreated-inoculated seed. These data included figures on stand, amount of disease, effect on nodulation, and the effect of nodulation on growth and nitrogen fixation.

The difference in stand data, taken as a whole, are not significant. The results of 1949-50 contradict those of 1951-52. Seed treatment did not seem to furnish the seedlings protection after emergence. In 1950-51 there was a significant difference in stand. Because of the very severe conditions under which these plants were grown, seed treatment may have accomplished some good. Since factors other than disease and seed treatment influenced the stand in that year, little significance may be given the data.

The Effect of Lupine Seed Treatment on Root Rots: Four hundred and fourteen plants from 48 rows, equally divided between treated and untreated seed, were examined for diseased roots and many specimens were plated for pathogen determination. Plants grown from untreated seeds showed 44.1 percent root infections, and 36 percent of the plants from treated seeds were infected. The most common types of infection were caused by Fusarium

Table 5. Effect of seed treatment with chloranil on weight and nitrogen content of lupine plants and on yields per acre. Summary of 1951-52 data based on a stand count of 166100 plants per acre.

Treatment	Weight		Nitrogen	
	Average per plant (grams)	Green weight per acre (pounds)	Average per plant (percent)	Pounds per acre
Seed treated				
Feb. 26	24.6	9004	3.3	35.7
Mar. 26	84.6	30939	2.9	105.6
Untreated				
Feb. 26	32.5	10958	3.7	48.5
Mar. 26	119.8	40426	3.1	149.4

and Rhizoctonia spp. A few roots with lesions caused by Glomerella cingulata were found. A large percentage of the infected roots contained nematodes, mostly of scavenger species.

The Effect of Seed Treatment on Nodulation, Plant Growth, and Nitrogen fixation: In 1949-50 data were obtained on nodulation only. Bitter blue lupine was used as a test crop. Because of the way nodulation takes place in this variety, it proved very difficult to obtain accurate data. Nodules of various sizes occurred up and down the central root and also on the branch roots. Data were taken on January 31 and February 24. In each case approximately 400 plants were dug at random from each treatment.

In 1950-51 no nodulation data were obtained because of the freeze. In 1951-52 a change was made to sweet yellow lupine. This variety has a strong tap root with the greater part of the nodulation within a limited area on the root, which makes it easier to obtain accurate data. It was also possible to collect data on plant weight and nitrogen content. Data were taken on February 26 and March 26, 1952, reported in Tables 3 and 4, respectively. Results are similar to those obtained in the 1949-50 season. Increased plant growth is correlated with increased nodulation and increased nitrogen content.

By using the data contained in Tables 3 and 4, along with stand data, it is possible to work out some interesting agronomic information on an acre basis (Table 5).

Conclusions and Discussion

The treatment of lupine seed with Spergon under the environmental conditions pertaining to the Georgia Coastal Plain region reduced nodulation, growth, and nitrogen fixation to a marked degree. It does not follow that this would always take place whenever legume seed are treated with Spergon. Because of the susceptibility of lupine to a number of soil-borne diseases, it is desirable that the crop be planted not more than once in a three-year rotation. It is difficult to maintain a high population of Rhizobium bacteria in sandy soils under these conditions. A seed treatment that will give lupine seedlings a measure of protection against soil-borne disease organisms is very desirable, but not at the expense of plant growth and nitrogen content. Perhaps the solution lies in better inoculation methods. From an agronomic point of view, lupine grown as a green manure crop should be turned under as late as possible to take advantage of the increase in nitrogen content. The planting date of the following crop would have to be considered.

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EFFECT OF POST EMERGENCE FUNGICIDAL APPLICATIONS TO WHEAT PLANTS FOR CONTROL OF DWARF BUNT[1]

A. J. Pilgrim[2] and E. L. Waldee[3]

SUMMARY

Fall-sown wheat plants sprayed with Bordeaux mixture or dusted with Ceresan and lime six weeks after emergence from the soil had a lower percentage of bunted plants than did the untreated controls. The same fungicides applied to the plants three months after emergence had little or no effect on the incidence of dwarf bunt.

This report is being presented as a summary of preliminary studies of the dwarf bunt of wheat fungus.

Japanese workers, Kuribayashi and Ichikawa (1, 2), reported that post emergence spraying of fall-sown barley and wheat seedlings resulted in a definite decrease in the occurrence of stinking smut in wheat and barley in Japan. In their experiment 31 varieties of wheat were sprayed with Bordeaux mixture, copper sulfate, lime sulfate, or 0.1% mercurial chemicals. The nonsprayed wheat averaged 28 percent smut, while the sprayed plots averaged 2.2 percent smut.

Tingey (3) and Tyler (4) stated that seed treatment with New Improved Ceresan did not give satisfactory control of the dwarf bunt, Tilletia caries (DC.) Tul. (Tilletia brevifaciens G. W. Fischer), of wheat in the United States.

METHODS

A portion of a field at Nephi, Utah, that had been badly infected with dwarf bunt in previous years was seeded to Utah Kanred wheat on October 2, 1947. Alternate rows were seed-treated with Semesan (1 oz. per bu.). Six weeks after emergence, November 16, 1947, the plants in a given number of rows were sprayed with Bordeaux (4-4-50) or dusted with one part Ceresan. Similar sets of rows were sprayed or dusted on January 11, 1948. An identical number of rows was sprayed or dusted in both November and January. A fourth set of rows receiving no treatment was used as the control. The percentage of bunted plants was noted at maturity.

RESULTS AND DISCUSSION

The data from the above experiment are summarized in Table 1.

The similarity of the dwarf bunt of wheat in Utah to the barley bunt in Japan indicated that a like response to fungicides might be expected when applied to emerged wheat. Although the overall incidence of dwarf bunt was considerably lower, the trend was similar to that reported by the Japanese workers. The plots sprayed or dusted in November showed a reduction in the percentage of bunted heads as compared to the control. No difference was noted in the counts of the diseased plants in the rows that had been seed-treated as compared with the counts in rows not seed-treated. Seed-treated plants in the controls showed 5.2 percent infection, while 5.3 percent of those untreated were bunted. An average of 5.0 percent infection was noted in other parts of the field outside the experimental plot. This confirms previous experience indicating that seed treatment is ineffective in controlling the dwarf bunt of wheat.

The effect of time of application of the treatments is shown in Table 2, in which the results with the different fungicides are combined. The November or early application of fungicides reduced the incidence of bunted plants, as did the November plus January treatments. The late application gave no significant evidence of control.

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[1] Work reported done in partial fulfillment of M. S. degree while senior author was a graduate student in Plant Pathology at Utah State Agricultural College, Logan.

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Table 1. -- Effect of post emergence fungicide application on dwarf bunt control.

Treatment	Total plants	Bunted plants	
	No.	No.	Pct.
Bordeaux spray November 1947	2950	13	0.47
Ceresan dust November 1947	3264	5	.15
Bordeaux spray November 1947 and January 1948	3044	57	1.20
Ceresan dust November 1947 and January 1948	2451	5	.20
Bordeaux spray January 1948	3284	135	4.10
Ceresan dust January 1948	3412	129	3.70
Control	3285	171	5.25

Table 2. The effect of time of application on incidence of dwarf bunt.

Treatment	Total plants	Bunted plants	
	No.	No.	Pct.
Early application November	6214	18	0.29
Early + late November & January	5495	62	1.13
Late January	6696	274	4.09
Control	6571	346	5.27

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FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE, COLLEGE STATION, TEXAS AND U. S. FOREIGN SERVICE, TEHERAN, IRAN

CONTROL OF SOIL-BORNE COMMON BUNT OF WINTER WHEAT IN THE PACIFIC NORTHWEST BY SEED TREATMENT[1]

C. S. Holton and Laurence H. Purdy, Jr.[2]

Introduction

Common bunt (Tilletia caries and T. foetida) of winter wheat in the Pacific Northwest is transmitted from one crop to the next by seed-borne and soil-borne spores. Effective control of infection due to seed borne spores is possible by seed treatment with an appropriate fungicide. Certain mercury and copper fungicides have been used for this purpose in the Pacific Northwest for many years. These materials, however, are not effective against infection by soil-borne spores. Hence, there has been a long-felt need for a chemical which, when applied to the seed, will control bunt originating from both seed-borne and soil-borne spores. This paper presents the results of tests with several chemical preparations which indicate that a product now commercially available under the brand name "Anticarie" gives satisfactory control. The active ingredient is 40% hexachlorobenzene. An experimental formulation of PCNB (pentachloronitrobenzene) also shows promise for control.

Table 1. Results of tests for the control of soil-borne common bunt by seed treatment with fungicides at two locations in the Pacific Northwest in 1953.

Treatment	Rate in ounces per bushel, location, and percent smut									
	1/2		1		2		4		8	
	Pullman	Moro	Pullman	Moro	Pullman	Moro	Pullman	Moro	Pullman	Moro
Untreated	35	20	24	12	25	7	34	8	29	12
Anticarie	0	0	0	0	0	0	0	0	0	0
PCNB 20%	13	12	0	4	0	2	0	1	0	0
PCNB 75%	26	1	11	1	1	0	0	0	0	0

Testing Procedure

Nine chemical preparations were tested in a two-year period. These included the standard mercury treatments for this region (Ceresan M, Agrox, and Panogen) and several non-mercury materials, including Anticarie.

Clean, uninoculated seed of the susceptible variety Elgin was treated with each preparation at rates of 1/2, 1, 2, 4, and 8 ounces per bushel in 1953. The 8-ounce rate was omitted in the 1954 test. The higher rates of application were accomplished by using a methyl cellulose sticker. Each test was replicated three times. Plots were grown at Pullman, Washington, and Moro, Oregon, in 1953 and at these same locations plus Pendleton, Oregon, in 1954.

With one exception the treated seed was planted in soil that had been contaminated by sprinkling a water suspension of common bunt spores in the opened furrows. At Moro in 1953 the test was made in naturally-infested soil. Smut percentages in each row were based on total heads. Summaries of the results obtained with some of the materials are presented in Tables 1 and 2 for 1953 and 1954, respectively.

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[1] Cooperative investigations of the United States Department of Agriculture, Agricultural Research Service, Field Crops Research Branch, and the Agricultural Experiment Stations of Oregon and Washington.

[2] Pathologist and Agent (Plant Pathologist), respectively, United States Department of Agriculture. We are indebted to W. E. Hall of the Sherman County Branch Experiment Station at Moro, Oregon, for his cooperation in growing the plots at that Station.

Results

In the 1953 test Anticarie gave perfect control at all rates of application, indicating incredible effectiveness against infection by soil-borne spores (Table 1). Two PCNB preparations were highly and consistently effective in both locations at rates of 2 ounces per bushel and above.

Results from the 1954 test generally confirmed those of 1953 but were less spectacular (Table 2). Anticarie was not adequately effective at the 1/2-ounce rate but gave good control at 1 ounce and excellent control at 2 and 4 ounces. PCNB 75% gave good control at the 2-ounce rate and above but equal to Anticarie only at the impractical 4-ounce rate. Although TCNB 50% (tetrachloronitrobenzene) gave inadequate control at all rates of application, it was sufficiently effective at the higher rates to warrant further consideration in formulations with higher percentages of the active ingredient.

The mercury preparations were completely ineffective at all rates of application. The apparent partial effectiveness of these materials at the 4-ounce rate reflects reduced stands resulting from seed injury. Other materials which proved ineffective were two PCNB preparations of European production and Mycon (7.5% methyl arsine sulfide).

Anticarie first came into use as a seed-treating agent against wheat smut (bunt) in France[3] where it also was later reported to be effective against infection by soil-borne spores[4]. Following its introduction into the United States, Anticarie was found to be effective against the soil-inhabiting dwarf bunt in the Pacific Northwest when applied to the soil simultaneously with the seeding operation[5]. It is not, however, effective against dwarf bunt when used as a seed dressing, as shown by the results from tests made in 1953 and 1954. In these tests, rows grown from treated seed had as much dwarf bunt as those grown from untreated seed. This fact, considered in relation to the effectiveness of Anticarie against dwarf bunt when applied to the soil and against soil-borne common bunt when applied to the seed, suggests a basic difference in the life cycles of the causal agents of these two kinds of bunt.

Table 2. Results of tests for the control of soil-borne common bunt by seed treatment with fungicides at three locations in the Pacific Northwest in 1954.

Treatment	Rate in ounces per bushel, location, and percent smut											
	1/2			1			2			4		
	Pullman	Pendleton	Moro	Pullman	Pendleton	Moro	Pullman	Pendleton	Moro	Pullman	Pendleton	Moro
Untreated	31	69	26	36	59	21	35	64	32	46	59	39
Antricarie	14	15	6	2	7	0.8	0.8	3	0.3	0.1	4	0.5
TCNB 50%	53	67	24	31	57	19	29	36	6	9	12	0.1
PCNB 75%	25	47	7	4	8	0.2	0.3	3	3	0	2	0
Agrox	29	66	21	20	65	17	17	62	16	10	17	8
Panogen	44	61	26	27	63	19	28	45	21	23	48	14
Ceresan M	29	67	13	27	57	14	22	53	12	16	69	13

WASHINGTON AND OREGON AGRICULTURAL EXPERIMENT STATIONS AND FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

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SEED-TREATMENT TESTS ON WINTER AND SPRING WHEAT AND OATS FOR SMUT CONTROL 1953-54

R. W. Leukel[1]

Experiments with Winter Wheat and Oats

In the fall of 1953, 22 chemical fungicides or mixtures were applied to bunt (Tilletia sp.)-infested seed of Purplestraw wheat and 19 of these were applied also to seed of Fultex oats[2] naturally infected with loose smut, Ustilago avenae (Pers.) Rostr. The equipment and methods used in applying the fungicides to the seed and in making germination tests have been described[3]. The wheat was sown in triplicated rod rows in the field two days after treatment, and in triplicated 5-foot rows in outdoor beds one week after treatment. The higher percentages of infection in the second planting indicate that temperature or moisture conditions or both were more conducive to infection after the second planting.

The oats were sown in the field and in outdoor beds three days after treatment. Germination tests of treated and untreated wheat were made three months and again six months after treatment. Infection data were taken in the 5-foot rows by counting the total and the infected heads in each row in both the wheat and the oats. In the rod-rows in the field the smutted heads were counted in all of the rows and the total heads were counted in representative rows. The number of heads in the other rows was estimated. These data are presented in Table 1.

Discussion

No explanation is offered for the contrast between 92.5 percent bunt in the first check and only 10.5 percent in the second check in the 5-foot rows, or between 76.3 percent and 26.7 percent in the rod-rows. Talc is an inert material frequently used as a diluent in dust fungicides and is not known to have any fungicidal properties. A similar effect was not observed in oats.

Bunt was controlled more effectively in the beds than in the field, although the two checks in the beds showed a higher degree of infection because environmental conditions after planting were more conducive to bunt infection. Fourteen treatments eliminated bunt in the beds, compared with only five in the field. Seventeen treatments in the beds reduced infection to less than 1 percent compared with only nine such reductions in the field. Since the beds were planted later than the field plots it is possible that the longer storage of the seed after treatments made the fungicides more effective in controlling bunt.

In the oats only Panogen eliminated smut in both series. Ceresan M and M2X controlled it in the 5-foot rows but allowed 0.4 and 0.1 percent, respectively, in the field. No other material except Dupont 244 reduced infection to less than 1 percent in either series. Mycon was less effective than in previous tests, possibly because of deterioration due to age. Although this product has been found very effective by several investigators, it will not be produced commercially. On the whole, the control of loose smut in oats was somewhat unsatisfactory, as only five materials reduced infection to less than 5 percent in both series of tests. It is possible that smut infection in this oat variety is more difficult to control than in some other varieties.

Experiments with Spring Wheat and Oats

Field tests of fungicides applied to bunt-infested seed of Red Bobs wheat and seed of Canadian oats naturally infected with loose smut and with covered smut (U. kolleri) were carried out at six experiment stations, with the generous cooperation of the following workers who planted the seed and took the data at their respective stations:

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[1] Pathologist, Field Crops Research Branch.

[2] The heavily infected Fultex oats were found on a farm near Denton, Texas, by Dr. I. M. Atkins, who generously sent a supply to Beltsville for testing fungicides. Such generous cooperation is greatly appreciated, as it makes more effective seed-treatment tests possible.

[3] Leukel, R. W. 1953. Cooperative tests of seed-treatment chemicals on spring wheat and oats in 1953., U. S. Department of Agriculture, Plant Dis. Reptr. 37: 587-594.

Table 1. (A) -- Emergence and bunt control in Purplestraw winter wheat grown from inoculated seed, treated as shown and sown in triplicate in 5-foot rows in beds near greenhouse, and in rod-rows in the field.
(B) -- Effect of same treatments on infection by loose smut in Fultex winter oats grown from naturally infected seed and similarly sown in beds and in field plots, 1953-54.

No.	Seed treatment			(A)				(B)	
	Material	Form	oz./bu.	Emergence after		Percent bunt in wheat in		Percent smut in oats in	
				3 mo.	6 mo.	Beds	Field	Beds	Field
1.	Check	--	--	70	74	92.5	76.3	54.2	20.5
2.	Ceresan M	Slurry	1/2	81	86	0	0	0	0.4
3.	Ceresan M2X	Slurry	1/4	79	85	0	0.1	0	0.1
4.	Dupont 244	Liquid	3/4	80	89	0	0	1.2	0.4
5.	Dupont 364	Liquid	1/2	78	82	0	0	10.0	7.4
6.	Mycon	Slurry	1	70	69	0	0	9.2	6.0
7.	Arasan SFX	Slurry	1	86	86	0	0.8	42.9	13.4
8.	Mycon + Arasan	Slurry	1	80	84	0	0.2	11.5	5.4
9.	Check + Talc	Slurry	1/2	79	83	10.5	26.7	55.7	17.6
10.	Pura C-4-10	Slurry	1/2	77	86	0	1.3	7.3	3.0
11.	Pura C-13-1212	Slurry	1/2	71	84	0	1.4	2.0	1.3
12.	Actidione (1%)	Slurry	1/2	54	75	1.0	1.7	12.7	7.9
13.	Actidione + Arasan	Slurry	1	64	57	0	1.2	13.4	9.1
14.	Actidione + Orthocide	Slurry	1	53	51	1.0	2.3	9.2	17.9
15.	MEML (SML 30)	Liquid	1/2	86	78	0.2	1.2	7.0	6.2
16.	MEMA-F.R. 161	Liquid	1/2	81	76	1.2	7.3	8.2	6.6
17.	Check + Water	Liquid	1	71	74	79.3	55.6	45.1	38.6
18.	Setrete	Liquid	1/2	76	74	0	1.2	2.1	6.0
19.	Panogen	Liquid	3/4	80	88	0	0	0	0
20.	Agrox	Slurry	1/2	85	82	0	1.4	13.2	7.0
21.	Crude helixin	Slurry	2	83	80	8.5	20.0	33.5	18.7
22.	275-D	Slurry	2	75	73	1.1	2.0	--	--
23.	Vancide	Liquid	4	87	89	0.1	1.2	--	--
24.	Anticarie	Slurry	1/2	74	76	0.3	1.5	--	--
25.	Anticarie + Arasan	Slurry	1 1/2	82	80	0	0.2	--	--

Table 2. Effect of different fungicides on emergence and seedling blight in Red Bobs wheat in

Table 2. Effect of different fungicides on emergence and seedling blight in Red Bobs wheat in infested greenhouse soil, on emergence in the field, and on bunt control at five stations in 1954.

Seed treatment applied				Percent emergence		Pct. seedling blight	Percent of heads infected at					
No.	Material	Form	Oz./bu.	Greenhouse	Field		Beltsville, Maryland	Blacksburg, Virginia	St. Paul, Minnesota	Madison, Wisconsin	Pullman, Washington	Average infection
1.	Check	--	--	90	79	34	23.2	5.6*	9.7*	8.6*	80.0	25.42
2.	Panogen 15	Liquid	3/4	94	90	16	0	0	0	0	0	0
3.	Panogen 42	Liquid	1/4	96	91	16	0	0	0	0	0	0
4.	Dupont 244	Liquid	3/4	97	89	13	0	0	0	0	0	0
5.	Dupont 364	Liquid	1/2	96	83	12	0	0	0	0	0	0
6.	MEMA	Liquid	1/2	94	90	12	0	0	0	0	0	0
7.	MEMA	Liquid	1/4	95	84	12	0	0	0	0	0.3	t
8.	Setrete	Liquid	1/2	94	84	9	0	0	0	0	0.2	t
9.	Ceresan M	Slurry	1/2	95	84	16	0	0	0	0	0.6	t
10.	Ceresan M-2-X	Slurry	1/4	97	86	13	0	0	0	0	0	0
11.	Check	--	--	92	79	36	21.1	64.1	30.1	15.4	80.0	42.16
12.	Pura C-13-1212	Slurry	1/2	95	86	12	0	0	0	0	0	0
13.	Pura-C-14-66	Slurry	1/2	93	88	13	0	0	0	0	0	0
14.	Mergamma	Slurry	1 1/2	89	83	15	0	0	0	0	1.2	0.24
15.	Agrox	Slurry	1/2	96	82	13	0	0	0	0	0.6	0.12
16.	Anticarie	Slurry	1/2	92	78	26	0	0	0	0	0.6	0.12
17.	Tritisan	Slurry	2	91	81	25	0	0	0	0	3.0	0.60
18.	N. P. 1083	Slurry	2	39	64	20	0	0	0	0	0.3	0.06
19.	Cu C03	Slurry	2	92	82	21	0	0	t	0	0.6	0.12
20.	B. Cu S04	Slurry	2	94	82	29	0	0	0	0	1.2	0.24

* These checks were "treated" in shipping due to lack of "insulation" from Panogen-treated seed.

Table 3. -- Control of loose and covered smuts in Canadian spring oats grown from naturally infected seed treated as shown and grown at five stations, 1954.

No.	Seed treatment			Percent smut recorded at					Average infection
	Material	Form	oz./bu.	Blacksburg	Madison	Urbana	Fargo	Pullman	
1.	Check	--	--	29.2	10.2	24.1	17.1	20.3	20.18
2.	Panogen 15	Liquid	3/4	0.3	0	0.1	0	0	0.08
3.	Panogen 42	Liquid	1/4	0.2	0.3	0	0	0.3	0.16
4.	Dupont 244	Liquid	3/4	0.6	0.2	1.2	0.5	0.3	0.56
5.	Dupont 364	Liquid	1/2	1.1	1.0	1.9	1.5	1.2	1.34
6.	MEMA	Liquid	1/4	0.3	0.4	0.4	0	0.2	.26
7.	Check	--	--	29.2	8.1	22.0	10.9	19.3	17.90
8.	Setrete	Liquid	1/2	3.1	0.2	2.2	0	0.8	1.26
9.	Ceresan M	Slurry	1/2	0	0.2	0.2	0	0	.08
10.	Ceresan M2X	Slurry	1/4	0	0.2	0.3	0.5	0	.20
11.	Puraseed	Slurry	1/2	0.7	0.2	0.4	0	0	.26
12.	Pura 14-66	Slurry	1/2	3.6	0.3	2.1	1.5	2.6	2.02
13.	BB-350-37	Liquid	1/2	0.4	0	1.3	t	0.2	.38
14.	BB-350-37	Liquid	3/4	0.4	0.3	0.8	0	0.5	.40
15.	BB-350-34	Liquid	3/4	0.5	0.1	1.8	0	2.8	1.04
16.	Ethyl Corp. 856	Slurry	1/2	--	--	18.2	--	--	--
17.	Ethyl Corp. 856	Slurry	1	--	--	24.2	--	--	--

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The wheat was inoculated with bunt spores at a 1 to 200 spore dosage, after which the fungicides were applied and subsequent germination studies made as previously described[4]. Treated and untreated seed was sent to cooperators at five stations, where it was planted in rod-rows and infection data taken at the proper time. These data are presented in Table 2. The Canadian oats seed was similarly treated, packeted, and shipped to the different stations for planting. The data on infection and smut control are shown in Table 3.

Experimental Results

It will be observed in Table 2 that at three stations there was a much lower percentage of bunt infection in the first check than in the second check. This was due to the failure in packeting to properly "insulate" the untreated seed in these packages from the seed treated with Panogen. All the other seed lots were separated from each other by sufficient material to prevent them from being affected by the neighboring lot of treated seed.

At four stations all the materials eliminated bunt. At Pullman, with 80 percent bunt in the checks, nine materials allowed from 0.2 to 3 percent infection. Five of these were mercurials. Only one material appeared to be harmful to the seed. The mercurials were more

[4] See footnote 3.

effective in checking seedling blight than were the five non-mercurials.

Infection by oat smut at the different stations ranged from 8.1 to 29.2 percent in plants from untreated seed, and from 0 to 3.6 percent from treated seed (with the exception of the one ineffective material tested at Urbana). Out of 13 treatments, nine reduced the average infection to less than 0.6 percent. The Ethyl Corporation-856 material appeared to be relatively ineffective.

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EFFECT OF CERTAIN SEED TREATMENTS ON STAND, YIELD AND SEEDLING BLIGHT IN SUNLAND OATS

Robert W. Earhart[1]

Field tests were conducted during the 1953-54 season to measure the relative effectiveness of two standard fungicides (Ceresan M and Panogen) in improving seedling stands and grain yields in Sunland oats, sown at the rate of 1 and 2 bushels per acre. The experiments were carried out at Gainesville and Quincy, Florida, and at Tifton, Georgia, in 12-foot rows, replicated four times at each station for each treatment and each rate of seeding.

The results obtained are presented in Table 1.

Table 1. The relative effectiveness of Ceresan M and Panogen in improving seedling stands and grain yields of Sunland oats.

Location	Seeding rate Bu./A	Seedling stands[a]					Grain yield., bu. per acre				
		Average stands			Percent increase		Average yield			Percent increase	
		No seed treatment	Ceresan M	Panogen	Ceresan M	Panogen	No seed treatment	Ceresan M	Panogen	Ceresan M	Panogen
Gainesville	2.0	168	284	270	69	61	41	45	44	9	7
	1.0	108	142	146	31	35	35	43	40	23	14
Quincy	2.0	150	276	248	84	65	16	37	31	131	94
	1.0	97	142	141	46	45	10	22	21	120	110
Tifton	2.0	212	284	223	34	5	27	41	37	5	37
	1.0	87	145	166	66	71	15	35	33	133	120

LSD 5% level -- rates x treatments x locations: 26 plants, 0.6 bushels
rates x locations: 29 plants, 1.6 bushels
treatments x locations: 28 plants, 1.9 bushels

[a] Average seedling count per 12-foot row.

Increases in stand resulting from seed treatment ranged from 5 to 84 percent, with no significant advantage for either chemical. Increases in yield ranged from 7 percent at Gainesville to 133 percent at Tifton. Yield increases from treated seed sown at 1 bushel per acre averaged 121 percent at Quincy and Tifton, while increases from the same seed sown at 2 bushels per acre averaged 78.5 percent at these two stations. At Gainesville, where yields from untreated seed were nearly two and three times as great at 2 and 1 bushel per acre, respectively, compared with the average yields at Quincy and Tifton, increases in yield due to treatment were less impressive.

Twelve seed-treatment fungicides were evaluated as to their effects on emergence and seedling infection in Sunland oats in tests conducted in the greenhouse at Gainesville.

These tests were carried out in greenhouse flats in MC-2-treated soil, with 120 counted seeds weighed out to secure a measure for weighing out seeds for each treatment. Six replicates of these tests were run. Infection percentages were obtained by taking approximately one fourth of the emerged seedlings from each replicate and compositing them for disease-indexing samples. Disease indexing was done by removing seedlings from the soil, washing them in tap water and macroscopically inspecting the sub-crown internodes for infection by either Hel-

[1] Prepared for publication by R. W. Leukel and J. H. Martin. W. H. Chapman grew the nurseries at Quincy, Florida, and D. D. Morey at Tifton, Georgia.

Table 2. Effects of 12 fungicidal seed treatments upon emergence and upon control of Helminthosporium infection in Sunland oats, after seed storages of 1 and 10 weeks following treatment.

No.	Seed treatment			Seedling				Protection[a] index	
	Fungicide	Form	Oz./bu.	Emergence		Infection			
				1 wk	10 wks	1 wks	10 wks	1 wk	10 wks
				No.	No.	%	%		
0.	None	--	--	96	95	96	92	1.0	1.0
1.	Arasan	Dust	1/2	113	126	79	46	1.4	2.7
2.	Mergamma**	Dust	1/2	115	112	59	43	1.9	2.6
3.	Orthocide 75	Dust	1/2	120	106	64	49	1.9	2.2
4.	Ceresan M	Dust	1/2	106	98	5	3	21.2	32.6
5.	Agrox**	Dust	1/2	112	113	22	22	5.1	5.1
6.	NP-1083*	Dust	1/2	116	117	77	69	1.5	1.7
7.	BB/LML/20**	Liquid	3/4	110	113	4	8	27.4	14.1
8.	Panogen	Liquid	3/4	113	106	19	5	5.7	21.2
9.	Mercusol	Liquid	3/4	116	117	62	54	1.9	2.3
10.	MEMA**	Liquid	3/4	101	106	3	3	33.7	35.3
11.	BB/LMA/10**	Liquid	3/4	118	113	22	21	5.4	5.4
12.	Pentrete*	Liquid	3/4	114	102	3	3	37.9	34.0
LSD 5% level				12	13	--	--	2.8	2.8

*Pennsylvania Salt Mfg. Co.

**Chipman Chemical Co.

[a] Protection index calculated by dividing emergence by percent infection.

minthosporium avenae or H. sativum. Emergence data represent averages of six replicates. Infection percent is based only on the actual composite sample; no LSD was calculated for the infection since only one composite sample was available. The data are shown in Table 2.

All treatments increased emergence and seven of them significantly reduced infection by Helminthosporium. Pentrete, MEMA, Ceresan M, BB/LML/20, and Panogen, in the order named, were most effective in the latter respect.

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OAT AND WHEAT SEED TREATMENTS: METHODS, INJURIES, AND GAINS

Benjamin Koehler and W. M. Bever

The experiments with wheat and oats reported here were conducted to secure additional information on four phases of seed treatment. These are: 1) methods of storing until planting of small experimental lots of seed treated with a volatile fungicide to obtain comparable results with those obtained by seedsmen or farmers, 2) the relationship of grain moisture to seed damage by fungicides, 3) relative seed injury by different volatile seed treating compounds, 4) yield benefits from treating seed relatively free from infection or infestation with pathogenic fungi. A few key references to the literature are listed.

Materials and Methods, General

Good quality seed of the current year's crop, grown on the Agronomy farm at Urbana, Illinois, and practically free from smut, scab, or blight infection was used except where otherwise noted. Each lot of seed was recleaned and thoroughly mixed before taking out sample portions for treatment. Each 1-pint sample was treated in a 1-quart Mason jar. All treatments, except where otherwise stated, were made by the slurry or quick-wet method. The chemical nature of the materials used is given by Leukel (5). For concentrated liquids such as undiluted Panogen, the liquid was distributed on the inner surface of the empty jar. The seed was then added, the jar closed and immediately vigorously shaken by hand for one minute. For larger amounts of liquids such as would be used in a slurry machine, the liquid or slurry was poured on the seed, the jar closed, and immediately shaken. Before treatment all jars were first conditioned for each fungicide and dosage by treating and discarding one lot of seed. The grain moistures listed are based on wet weights before treatment. The slurry treatments raised moistures from 0.5 to 1 percent.

Germination tests to determine seed injury were made in coarse building sand in a greenhouse bench at a temperature of about 70° F. The sand was first treated with a 1:100 formaldehyde solution and aired for a week so that the effect of seed treatment on the control of seedling blight caused by soil-borne organisms would not confuse the seed-injury effect. Fifty seeds were planted per row, the rows were randomized, and replicated six times for the data in Table 1, eight times for Table 2, and four times for each of three varieties for which averages are shown in Figure 1.

For the yield tests, ten replications of rod rows were sown with usual farm practices with respect to crop rotation, tillage, and date of planting being followed.

Storing Treated Experimental Seed Lots to Simulate Commercial Conditions

Holding treated seed for one or more days before sowing is recommended for all seed treated with volatile fungicides. In practice the treated seed often is stored for several days, weeks, months, or even years. An experiment was conducted to determine how small lots of treated seed might be stored so as to approximate the effects under commercial storage conditions. Wheat was treated with Ceresan M, a compound known to cause injury under some conditions. Injury to germination was used as a measure of the relative activity of volatile chemicals under several selected conditions of storage. The treated wheat was stored at room temperature for 150 days from September 1951 to February 1952.

Pawnee, a hard winter wheat, and Royal, a soft winter wheat, were used. The grain moistures were 12.5 and 12.7 percent, respectively. Since analysis of the data revealed no significant differences or interactions due to variety, the results for the two varieties are averaged together.

Simulated commercial storage conditions were of two kinds. By one method two coarse cheesecloth bags each holding a pint of treated wheat were dropped to the bottom of a 6-inch cylinder, 2 feet long, and closed air tight at the bottom. Each cylinder containing one bag of each variety was then filled with wheat having the same kind and rate of treatment as that in the cheesecloth bags. It was believed that the seed in the cheesecloth bags would be subjected to conditions of gas retention similar to that in the bottom of a bin of treated seed 2 feet deep. The other method was to place the cheesecloth bags in the center of a bushel of similarly treated seed contained in a 2-bushel canvas grain bag. This method was designed to duplicate conditions in bagged grain, but it is realized that where a number of bags of treated grain are placed in a pile, the seed hazard may be slightly greater than in this experiment, in which the

Table 1. Germination percentages of treated wheat in relation to rate of treatment and methods of storage before planting. (Ceresan M, applied by the slurry method). Average results with Pawnee and Royal varieties.

Length of storage period after treating	Condition of storage and kind of container	Dosage, oz./bu. 1/4	1/2	1
Days		Percent	Percent	Percent
0	Not stored	96.7	96.9	94.4
150	Kraft paper bag, closed	95.5	96.9	91.1
150	Mason jar, open continuously	95.8	95.4	85.4
150	Mason jar, closed 3 days, then open	95.8	96.4	83.4
150	At bottom of cylinder, 2 feet deep[a]	96.2	93.2	81.4
150	In middle of 1-bushel lot in grain sack[a]	95.5	93.3	80.8
150	Mason jar, closed continuously	95.9	92.5	77.7
	L.S.D. at 5% level = 3.0			

[a] Simulated commercial storage conditions.

bags had to be isolated because of differences in treatment.

The paper bags (Table 1) were of the ordinary Kraft paper, 2-pound size, folded over and over from the top and fastened with paper clips. They were stored on a rack with space between all bags. The 1-pint Mason jars used were filled to capacity.

At the 1/4-ounce rate of application of Ceresan M, there were no significant differences in germination between any of the methods (Table 1). At the 1/2-ounce rate there was significantly less injury when the seed was stored in the paper bags than in the two simulated commercial storage conditions. Differences in seed damage at the 1-ounce rate were most pronounced and probably furnish the best data for determining comparable chemical activity of the fungicide under the various storage conditions. The Kraft paper bags apparently were very porous to the gas liberated by Ceresan M as the seed was affected less than by storing in a jar open at the top. Only in the continuously closed jars was the injury greater than under simulated commercial storage conditions, although it ranked close to those conditions in this test. Closing the jars for three days and then opening them appeared to be the closest approximation to commercial storage conditions. With shorter storage periods, this condition would approach the commercial conditions still more closely. Another suggested method would be to keep the treated seed in a closed container for three or four days, and then place it into envelopes in an open tray with precautions to keep envelopes containing unlike treatments out of contact with each other. By this method the length of storage after packaging should effect the results only to a slight degree.

In attempting to simulate commercial storage it should be recognized that the vapor lost is affected by the porosity of the container and the size of sample. Hansing (3) used double, extra heavy, paper bags containing 1 liter of seed, but made no direct comparison with commercial storage.

Published reports on injury to germination by New Improved Ceresan and Ceresan M following storage of treated seed are not in agreement. Differences in storage conditions that influenced gas escapement (Table 1) or in susceptibility of seed lots to damage by treatment (Table 2, oats) may have affected the results.

Effect of Grain Moisture on Damage to Germination by Fungicidal Treatment

In 1951 there was exceptionally heavy rainfall in the soft wheat-growing area of Illinois and the moisture content of wheat was unusually high at harvest. When this wheat was used for seed some very poor stands were observed, particularly where the seed had been treated.

Seed of three wheat varieties, Pawnee (hard), Prairie (soft), and Vigo (soft), was used in an experiment to determine the effect on germination of the moisture content of treated seed.

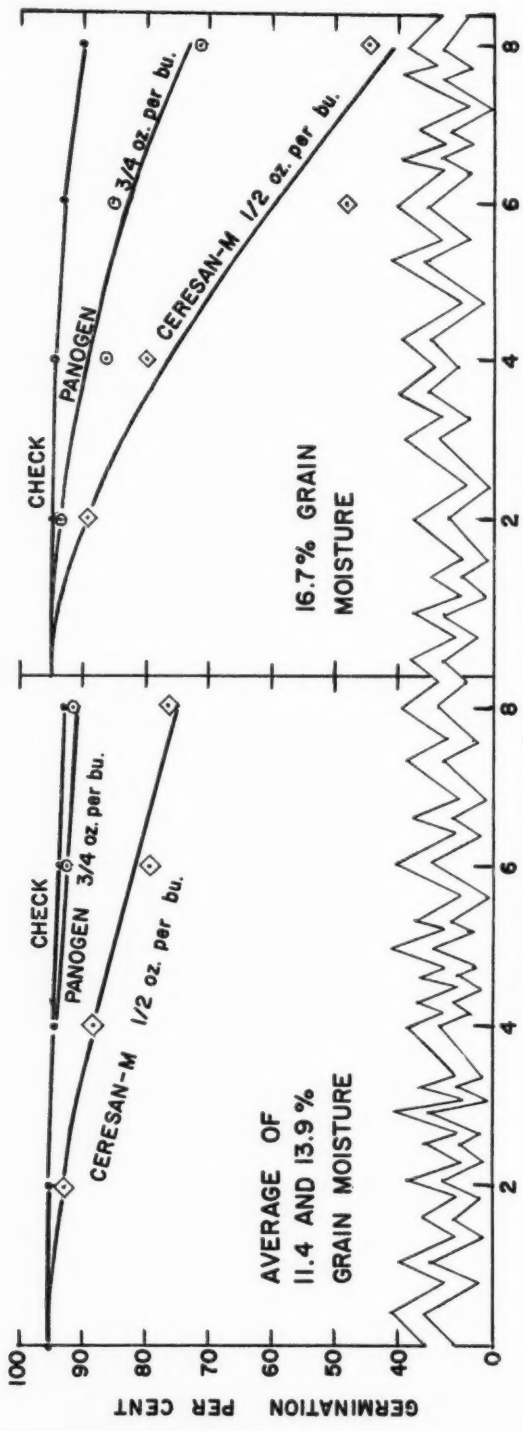

FIGURE 1. Graphic presentation of germination percentages of wheat in disinfected coarse sand, showing the influence of time, grain moisture, and kind of fungicidal treatment. Average results from three varieties, Pawnee, Prairie, and Vigo.

Table 2. Stands of wheat and oats when seed had been treated with various fungicides and stored in closed jars for 10 months Urbana, Illinois -- February, 1954.

Treatment		Emergence in disinfected sand			
Fungicide	Rate	Wheat		Oats	
		Pawnee	Vigo	Clinton	Mo. 0-205
	oz./bu.	Per-cent	Per-cent	Per-cent	Per-cent
Untreated check (1)	--	95	89	98	99
" (2)	--	93	91	98	100
Ceresan M	1/2	55**	77**	96*	99
"	1	34**	56**	88**	98
Panogen 21	3/4	77**	86*	97	99
"	1 1/2	47**	75**	95**	99
Setrete	1/2	82**	87	97	100
"	1	67**	78**	93**	98
Agrox	1/2	75**	83**	96*	99
"	1	57**	70**	91**	99
Mergamma	2	32**	44**	89**	97**
M.E.M.A.	1/2	91	89	99	99
"	1	89**	89	98	99
Mycon	1/2	91	84**	99	100
"	1	84**	84**	97	100
"	2	60**	57**	93**	96**
Orthocide 75	2	93	87		
"	4	91	84**		
Ortho Seed Guard	1 1/2	81**	78**		
"	3	66**	64**		
Vancide 51	4	96	89		
"	8	92	90		
Anticarie	1/2	95	88		
"	1	96	91		

* Significantly lower than the untreated checks at the 5 percent level.
** Significantly lower at the 1 percent level. Based on conversion of stand percentages to angles.

The initial grain moistures were 11.0, 11.5, and 11.7 percent, respectively, for the three varieties. For higher moistures the grain of each variety was conditioned by adding the desired amount of water to the seed in a can, closing tightly, and mixing daily for a week before applying seed treatments. The final moisture percentages, as indicated in Figure 1, are the averages for the three varieties as determined at the time the treatments were made. Ceresan M was applied as a dust at 1/2 ounce per bushel and Panogen in the concentrated form at 3/4 ounce per bushel so as not to change the grain moisture appreciably. The treated seed was stored in closed jars kept at a temperature of about 70° F. Germination tests were made at two-week intervals for eight weeks. The results are shown graphically in Figure 1. Since the germination percentages at the 11.4 and 13.9 percent moistures were practically the same, they were averaged together. Vigo was injured slightly more than the other two varieties after six and eight weeks' time, but for simplicity the results from all three varieties are combined. An increase in moisture from 13.9 to 16.7 percent as well as an increase in time caused marked increases in seed damage, and there was a highly significant difference in the amount of damage caused by the two fungicides used. This difference cannot be attributed to differences in volatility, for the active ingredient in Panogen is more volatile than that in

Table 3. Percent smut infection and yields of oats as affected by rate of treatment with two fungicides. Urbana, Illinois, 1951.

Fungicide	Rate of application	Smut-infected seed[a]		Smut-free seed[b]	
		Smut	Acre yield	Smut	Acre yield
	Oz./bu.	Percent	Bu.	Percent	Bu.
None	-	10.2	37.1	0.0	65.2
Ceresan M	1/4	0.0	53.2	0.0	68.9
"	1/2	0.0	55.4	0.0	65.6
Panogen	3/8	1.1	50.9	0.0	69.2
"	3/4	0.1	53.6	0.0	70.7
L.S.D. at 5% level			4.7		1.5

[a] Canadian oats, obtained from H. C. Murphy, Ames, Iowa.
[b] Average of three varieties, Clinton, Andrew, and Nemaha.

Ceresan M (1).

Effect of Various Fungicides on Seed Germination

Six volatile and three non-volatile fungicides were used in addition to Mergamma which contained a volatile fungicide and also a volatile insecticide, and Ortho Seed Guard which contained a non-volatile fungicide plus a volatile insecticide. Only the volatile fungicides were used for oats because non-volatile fungicides are unsatisfactory for controlling smuts of seeds enclosed in hulls. Two varieties of wheat, Pawnee and Vigo, and two of oats, Clinton and Mo. 0-205, were used. The moisture content of the untreated grain, in the order named above, was 9.5, 11.0, 9.6, and 10.0 percent. Most of the fungicides were used at the recommended and twice normal rates. Treated and untreated samples were stored for ten months in closed jars at room temperature, using a cool basement during the summer months.

A significant interaction between treatment and variety was found for both wheat and oats. Therefore, the data for all varieties are included in Table 2. Wheat was injured more than oats, as had been anticipated (2, 6). In wheat, most of the volatile compounds caused a highly significant decrease in germination at the recommended dosage. Differences in relative injury to germination were in some cases not related to differences in volatility. MEMA, which appears to rank high in volatility, caused surprisingly little damage to germination. At the recommended rates, aside from Mergamma, significant decreases in germination of oats occurred with Ceresan M and Agrox, and in the Clinton variety only. Seed lots vary in the amount of injury caused by treatment when tested under the same conditions, but the extent to which these variations are due to varietal differences has not been determined.

Ceresan M has been known to be damaging to the germination of grain when not used correctly. Both fungicidal and phytocidal effects are governed by time, dosage, and other factors. Fortunately the former action usually is adequate for seed-borne fungi before the latter becomes noticeable. Thus with proper care Ceresan M has been used successfully for controlling certain diseases and increasing yield of small grains.

In setting up this experiment, the criterion for evaluating results was that no treatment would be acceptable for recommendation that caused more damage than Ceresan M. Only one compound, Mergamma, fell into this category when treatments were made at the recommended rates. It was recognized also that there would be special merit in materials that would cause less injury than Ceresan M, provided they were satisfactory in other respects. Experiments with Panogen have been extensive enough to indicate it may be included in this class. Some of the other volatile fungicides tested look very promising, but there has not yet been enough experimentation for critical evaluation, especially for yield. Perhaps some are not sufficiently volatile to be entirely satisfactory for seed-borne disease control of hulled seeds like oats and barley.

Effect of Seed Treatment on Yield of Oats

There is considerable interest in the question as to whether it pays to treat the seed of small grains each year in the humid areas of the United States. Seed, when only one year removed from treatment, is relatively free from smut amenable to control by seed treatment. Furthermore, there is a gradually increasing availability of seed of smut-resistant varieties. No spectacular benefit from treatment of smut-free grain can be demonstrated except in unusual cases of severe infection with other diseases, such as Victoria blight (1, 3). Taylor and Leukel (8) worked with good quality wheat seed and obtained no significant differences due to treatment. Shands and Arny (7) used both good and poor quality (weathered) oats. Ceresan M gave average increases in yield from poor quality seed while Panogen gave increases, on the average, for both kinds of seed.

A seed treatment-yield experiment was conducted in 1951. Four varieties of oats were used, one smut-infected and three smut-free. Treatments were made six weeks before planting and the treated seed was stored during this interval by placing the samples within a bushel lot of similarly treated seed within a canvas grain sack as described previously.

Significant increases in yield from treatment were obtained in this test with both smut-infected and smut-free seed (Table 3). With smut-infected seed, differences between fungicidal treatments were not significant. For smut-free seed, there were three varieties, and with ten replications of each, sufficient precision was obtained to make differences between treatments measurable. The results with Ceresan M are comparable to those obtained in earlier experiments with New Improved Ceresan (4); namely, that if treated seed is stored for some time under conditions somewhat comparable to commercial practice, better yields are obtained with 1/4 ounce than with 1/2 ounce per bushel.

Yields following Panogen treatment were not improved by reducing the dosage to half normal.

The increases in yield, from treatment of nearly disease-free seed, appear to be due to protection against some soil-borne organisms. A half-normal treatment would probably tend to minimize this protection. With some fungicides, when planting of treated seed is delayed for some weeks, there is a delicate balance between the best dosage to avoid seed damage and the best dosage to give yield increases through protection against soil organisms. The results from some yield tests indicate that seed injury from treatment had completely counteracted any gains in yield that might otherwise have been obtained. Further experiments with relatively disease-free seed treated with some of the newer "safer" fungicides (Table 2) are suggested. In such experiments it will be particularly helpful if the treated seed is stored under conditions comparable to commercial practice for three to seven days, or longer, before planting, and if the field plot technique is adequate to measure small differences in yield.

SUMMARY

One-pint lots of treated seed were stored under a number of conditions to determine how small lots may be handled in order to approximate effects equivalent to those obtained with larger lots. Storage in paper bags gave results least comparable to those obtained under simulated commercial conditions as measured by percentage of germination. Holding the treated seed in sealed 1-pint Mason jars for three days and leaving them open thereafter most nearly approached the results obtained from those set up as standards in this experiment. It appears to be a satisfactory method when the influence of period of storage is not a part of the experiment.

Damage to germination by volatile mercury compounds was increased with an increase in dosage, time, and grain moisture content. However, there were wide differences in fungicidal seed-treating compounds with respect to the amount of damage. Differences in relative injury to germination were in some cases not proportional to differences in volatility. There was no increase in seed damage at 13.9 percent grain moisture as compared to 11.4 percent. But at 16.7 percent there was a marked increase in damage to germination over that at the lower moisture.

One wheat variety suffered more seed damage than two others under the same moisture and environmental conditions. In another experiment one oat variety was injured more than another one. Whether these variations could be attributed to varietal differences or to other causes has not been determined.

It is concluded that if good quality, lightly infected or nearly disease-free seed is to be treated and stored for two or more weeks before planting, Ceresan M should be applied at half

the standard rate in order to obtain maximum yields. Protection against soil-borne organisms should be better at higher rates of application, but in the writers' experience, if higher rates are used, seed injury may at times entirely negate increases in yield from treatment. With Panogen, less prone to injure seed, best yields were obtained at the standard recommended dosage even after six weeks of storage.

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ILLINOIS AGRICULTURAL EXPERIMENT STATION AND THE FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE

SORGHUM SEED-TREATMENT TESTS IN 1954

R. W. Leukel, O. J. Webster, and R. H. Porter[1]

In 1954 seed-treatment tests for the control of covered kernel smut (Sphacelotheca sorghi) on sorghum were conducted at Beltsville, Maryland, Lincoln, Nebraska, and Ft. Collins, Colorado.

Materials and Methods

Sixteen fungicidal materials were applied to Sharon kafir, the seed of which threshes free of the glumes, and to Rancher sorgo seed, which retains its glumes. The seed was first thoroughly cleaned and then inoculated with spores of covered kernel smut at a 1 to 200 spore dosage. Separate 500 cc. portions were then treated with the different chemicals at the Plant Industry Station in a manner previously described in detail, along with the composition and sources of most of the fungicides used[2]. Counted portions of the different seed lots were sent to Lincoln, Nebraska, and Ft. Collins, Colorado, for planting at the rate of 200 seeds per row. Stand counts in the field were made at Lincoln and at Ft. Collins. Soil washing, due to heavy rains after planting, made stand counts at Beltsville futile. However, studies on emergence from treated seed and from untreated seed were made in non-sterile soil in control chambers. Data on smut control were obtained at all three stations by counting the smutted heads and the total number of heads in each row. These data and the data on emergence are presented in Table 1.

Experimental Results

None of the fungicides seemed to cause a highly significant increase in emergence from kafir or sorgo seed in the laboratory tests. Emergence from the treated kafir seed ranged from 83 to 91 percent and averaged 87 percent compared with 84 percent from the untreated seed. Emergence from treated sorgo seed ranged from 81 to 94 percent and averaged 91 percent compared with 92 percent from untreated seed.

In the field at Lincoln, stands from treated kafir and sorgo seed averaged 47 and 59 percent, respectively, compared with 32.5 and 58 percent in the checks. Corresponding figures for treated seed at Ft. Collins were 60 and 48 percent, respectively, with 61 and 42 percent, respectively, in the checks.

Twelve of the materials tested eliminated covered smut in Sharon kafir at all three stations. Dupont 244 allowed 0.3 percent at Ft. Collins, MEMA allowed 0.7 percent and Arasan S.F.X. 0.4 percent at Beltsville. Ethyl 856-I, which was only 50 percent effective in Sharon kafir at Beltsville, allowed only 1.2 percent smut at Lincoln and none at Ft. Collins.

Smut control in Rancher sorgo, in general, was highly unsatisfactory even by the mercurials, which were surpassed in effectiveness at all three stations by the non-mercurial organic, Phygon. No suitable explanation is offered for the relative ineffectiveness of the standard mercuric fungicides in the control of smut in Rancher sorgo. The seed had been carefully treated in glass jars May 14, and allowed to remain in these containers for three days. It was then stored in paper envelopes for two weeks before it was planted at Beltsville, and for a longer period before planting at the other two stations. In similar previous experiments with Leoti sorgo, the seed of which also retains its glumes, the mercurials, with few exceptions, had eliminated smut.

Ceresan M, which is generally used as a standard of comparison, was not included in these tests because the sample to which it had been applied was accidentally spilled.

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[2] Leukel, R. W. 1953. Cooperative tests of seed-treatment chemicals on spring wheat and oats in 1953. Plant Dis. Reptr. 37: 587-593.

Table 1. Percent emergence and percent of heads infected with covered kernel smut in Sharon kafir and Rancher sorgo from seed inoculated with smut spores at a 1 to 200 spore dosage, treated as shown, and planted in triplicated field plots at three stations in 1954.

No.	Seed treatment: Fungicide	Form[b]	Oz./bu.	Percent emergence[a]: Beltsville Kafir	Beltsville Sorgo	Lincoln Kafir	Lincoln Sorgo	Ft. Collins Kafir	Ft. Collins Sorgo	Percent of heads smutted in: Sharon kafir at Beltsville	Sharon kafir at Lincoln	Sharon kafir at Ft. Collins	Sharon kafir at Average	Rancher sorgo at Beltsville	Rancher sorgo at Lincoln	Rancher sorgo at Ft. Collins	Rancher sorgo at Average
1.	Check	--		84	92	32	57	64	43	23.7	78.9	3.0	35.2	5.9	5.8	16.2	9.3
2.	Panogen	Liquid	3/4	91	93	46	57	52	54	0	0	0	0	1.0	1.5	3.8	2.1
3.	Dupont 244	Liquid	3/4	88	81	52	52	55	41	0	0	0.3	0.1	2.3	6.6	0.8	3.2
4.	Dupont 364	Liquid	1/2	85	87	50	67	58	43	0	0	0	0	2.3	6.4	7.9	5.5
5.	Setrete	Liquid	1/2	90	88	41	65	58	48	0	0	0	0	4.0	4.4	11.1	6.5
6.	Merculine	Liquid	1/2	85	93	41	57	65	47	0	0	0	0	3.6	3.4	4.9	4.0
7.	MEMA	Liquid	1/3	88	91	51	64	59	56	0.7	0	0	0.2	1.9	6.9	12.8	7.2
8.	Mergamma	Slurry	3	84	92	68	73	72	57	0	0	0	0	1.5	5.2	8.8	5.2
9.	Agrox	Slurry	1/2	83	88	48	54	64	45	0	0	0	0	1.3	5.3	8.5	5.0
10.	Check	--	--	84	92	33	59	58	41	35.9	79.4	2.4	39.2	2.3	12.4	13.5	9.4
11.	Puraseed	Slurry	1/2	85	92	30	58	63	47	0	0	0	0	0.5	0.6	4.2	1.8
12.	Pura C-14-66	Slurry	1/2	90	89	41	56	60	47	0	0	0	0	1.0	4.6	12.8	6.1
13.	Orthocide	Slurry	2	91	94	46	59	66	48	0	0	0	0	3.6	3.0	8.4	5.0
14.	Ethyl 856-I	Slurry	2	85	92	44	59	55	44	15.6	1.2	0	5.6	7.3	18.7	17.6	14.5
15.	Arasan S.F.X	Slurry	2	91	93	56	52	60	40	0.4	0	0	0.1	2.7	2.8	5.5	3.7
16.	Spergon	Slurry	2	84	92	48	58	54	46	0	0	0	0	3.6	0.6	5.2	3.1
17.	Phygon	Slurry	2	84	93	50	63	65	52	0	0	0	0	0	0.3	0	0.1
18.	$CuCO_3$	Slurry	2	91	90	47	48	55	52	0	0	0	0	2.4	4.4	5.1	4.0
	Average[c]			87	91	47	59	60	48								

[a] Emergence data were obtained in chambers kept at 50° F. for 4 days and then at 78° F. at Beltsville, and in the field at Lincoln and Ft. Collins.

[b] Liquid or slurry.

[c] From treated seed.

TOBACCO BLUE MOLD CONTROL WITH ZINEB DUSTS

E. E. Clayton and John J. Grosso

SUMMARY

A 10% commercial zineb-tobacco dust was compared with a 10% zineb-pyrophyllite mixture. The zineb-tobacco dust gave relatively poor blue mold control; the zineb-pyrophyllite dust gave good blue mold control. Applied as spray, both gave good blue mold control, indicating that the zineb in both mixtures was active fungicidally. The effectiveness of the zineb-tobacco mixture was improved by additions of zineb, but a 20% zineb-tobacco gave less effective blue mold control than a 10% zineb-pyrophyllite. It is concluded that the tobacco dust was mechanically a less efficient carrier of the fungicide than the pyrophyllite, and to obtain equal blue mold control the zineb-tobacco mixture would need to contain more than two times as much zineb.

Blue mold (Peronospora tabacina) disease of tobacco can be effectively controlled by ferbam and zineb dusts. For the preparation of these mixtures, pyrophyllite is a recommended diluent, while Fuller's earth and clay diluents are not satisfactory, since they promote deterioration of the carbamate fungicide. Recently tobacco dust has come into extensive use as a diluent in the areas where blue mold fungicides are applied to field tobacco. In the spring of 1954 a report was recieved of failure to obtain satisfactory blue mold control with a 10% zineb (Dithane Z-78) dust diluted with pulverized tobacco[1]. Supplies of this commercial mixture were obtained and it was tested in comparison with a freshly mixed zineb-pyrophyllite.

Experiment 1 -- The test plants used were in 2-inch pots and were about six weeks old. There were 12 individual plants in each treated lot and a similar untreated check was included. The test dusts were applied by hand, using cheesecloth shaker bags. Applications were made May 4, 7, 10, 12, and 14. The plants were sprayed with blue mold fungus spores on May 5 and 6. Throughout the experiment plants were held under conditions favorable for the development of blue mold.

Data were taken in terms of diseased leaves -- that is, leaves showing evident fungus growth on the lower surface. The first counts were taken on May 17, three days after the last dust application. Results are given in Table 1.

After a series of thorough dust treatments, such as were given these plants, practically perfect blue mold control would be expected for a subsequent period of one week. Not only did the zineb-tobacco dust fail to give perfect control, but in addition the blue mold developed on these leaves as quickly, and the lesions increased in size as rapidly, as with the untreated check. The second set of data were taken on May 19 and a third set on May 21, respectively, five and seven days after the last dust application. These data, given in Table 2, indicated no change in the disease situation.

It was observed that, whereas the zineb-pyrophyllite dust adhered closely to the leaf surface, the zineb-tobacco dust particles tended to be caught by the leaf hairs. It seemed, therefore, that the problem could be one of coverage and leaf surface contact, and on this basis it was reasoned that a spray application might give a different result, hence the following test.

Experiment 2. The sprays were prepared to give 3 pounds per 100 gallons of actual zineb. Application dates were May 5, 7, 11, and 14. Inoculations were made on May 6 and 7.

As indicated in Table 3, during the course of the experiment, including the seven-day period following the last spray application, both zineb-tobacco and zineb-pyrophyllite sprays gave perfect blue mold control. These results indicated that the zineb in the tobacco mixture had not deteriorated fungicidally and that with a different method of application, it did give effective blue mold control.

Experiment 3. It seemed of interest finally to determine the result of adding more zineb to the tobacco dust mixture. The added zineb was from the same lot used to make up the 10% pyrophyllite dust, and additions were in amounts to give 15% and 20% zineb-tobacco dusts. Ten plant lots in 2-inch pots were used. Dust applications were made May 19, 21, 24, 26, and 28.

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[1] A product of the Tobacco By-Products and Chemical Corporation.

Table 1. Tobacco blue mold control by zineb dusts, counts three days after the last dust application.

Treatment	Diseased leaves	Disease control
	Number	Percent
Untreated check	28	0
Zineb-tobacco	9	68
Zineb-pyrophyllite	0	100

Table 2. Tobacco blue mold control by zineb dusts, counts five and seven days after last dust application.

Treatment	Diseased leaves after		Degree of control	
	5 days	7 days	5 days	7 days
	Number	Number	Percent	Percent
Untreated	35	38	0	0
Zineb-tobacco	11	11	68	68
Zineb-pyrophyllite	1	1	97	97

Table 3. Tobacco blue mold control by zineb sprays, counts four and seven days after last application.

Treatment	Diseased leaves after		Degree of control after	
	4 days	7 days	4 days	7 days
	Number	Number	Percent	Percent
Untreated	19	21	0	0
Zineb-tobacco	0	0	100	100
Zineb-pyrophyllite	0	0	100	100

Table 4. Tobacco blue mold control by zineb dusts, counts at the time of the final dust application.

Treatment	Diseased leaves	Degree of control
	Number	Percent
Untreated	20	0
Zineb 10%-tobacco	9	59
Zineb 15%-tobacco	5	77
Zineb 20%-tobacco	2	91
Zineb 10%-pyrophyllite	0	100

Table 5. Tobacco blue mold control by zineb dusts, counts seven days after last application.

Treatment	Diseased leaves	Degree of control
	Number	Percent
Untreated	34	0
Zineb 10%-tobacco	23	32
Zineb 15%-tobacco	21	38
Zineb 20%-tobacco	9	73
Zineb 10%-pyrophyllite	3	91

Inoculations were made May 20 and 21. First sporulation was observed May 28 and counts were taken as shown in Table 4.

It will be observed that the blue mold control obtained with the 10% zineb-tobacco dust was even less satisfactory than in Experiment 1. The surprise, however, was performance of the 20% zineb-tobacco mixture. This dust had the original 10% zineb plus another 10% of the same zineb that was used to make up the zineb-pyrophyllite dust. This 20% zineb-tobacco was actually not quite as effective as the 10% zineb-pyrophyllite, -- 91 percent control as compared with 100 percent control. A second, and final, disease count was made seven days later. (Table 5).

These final counts were further confirmation of the fact that the 20% zineb-tobacco mixture was actually less effective than the 10% zineb-pyrophyllite, though very much more effective than the original 10% tobacco mixture.

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VARIATION IN PATHOGENICITY OF PHYTOPHTHORA PARASITICA VAR. NICOTIANAE

J. L. Apple

Black shank of tobacco caused by Phytophthora parasitica (Dast.) var. nicotianae (Breda de Haan) Tucker, was first identified in North Carolina in 1930 (5) and has spread progressively throughout the flue-cured tobacco growing area of the State (3). Breeding for resistance was initiated in 1932 and flue-cured tobacco varieties resistant to this disease were subsequently developed, the first being released in 1943 (1). Since that time resistant varieties have been the principal means of control. Prior to 1951, the degree of control afforded by these varieties was satisfactory, with losses rarely exceeding 5 percent. The fact that disease levels in resistant varieties remained relatively constant over a period of several years led to the assumption that P. parasitica var. nicotianae was pathogenically stable. However, as early as 1951 many fields planted to resistant varieties were observed in which losses occurred in excess of 50 percent. Similar observations of fields with unusually heavy losses were more numerous in 1952 and increased still more in 1953. Among the possible factors involved, only the following have been studied: 1) predisposing effect of root injury caused by plant parasitic nematodes and/or 2) the existence of strains of the black shank fungus possessing increased virulence.

Nusbaum and Chaplin (4) found the incidence of the black shank disease to be reduced in a resistant variety following the application of a nematocide, and suggested that root injury caused by plant parasitic nematodes may alter the expression of the inherent black shank resistance of certain tobacco varieties. Later, Sasser et al. (7) demonstrated the validity of this suggestion by greenhouse inoculation studies. Although plant parasitic nematodes may predispose a resistant plant to attack by the black shank fungus, numerous situations have been encountered in which the moderately resistant Dixie Bright 101 variety was severely diseased in the absence of an appreciable number of any recognized forms of plant parasitic nematodes. These latter observations suggested the possibility of the existence of highly pathogenic strains of P. parasitica var. nicotianae.

Studies of variation in pathogenicity of the black shank fungus have been few in number and limited in scope. Nolla (2) found an isolate from Sumatra that caused slower disease development than other isolates tested; however, he concluded that this was possibly due to the old age of the culture. Powers and Lucas (6) reported a strain of the black shank organism from North Carolina to be weakly pathogenic because of its failure to attack detached and wounded leaf or stem tissue as rapidly as a "normal" isolate. However, certain isolates of P. parasitica obtained by the writer from hosts other than tobacco attacked unwounded tobacco leaf tissue but did not attack a growing plant. Thus critical evaluation of the level of pathogenicity of a given isolate cannot be made by inoculations of detached tobacco leaves.

Since no comprehensive investigation of variation in pathogenicity of P. parasitica var. nicotianae has been made and because of its possible importance to the present black shank disease problem in North Carolina, a study has been undertaken. The preliminary findings are herein reported.

Over 200 isolates of the black shank fungus were obtained from North Carolina (44 counties), eight other States, and five foreign countries. The pathogenicity of many of these isolates has been determined in greenhouse inoculation studies by means of the following technique: seedlings of two tobacco varieties, moderately resistant Dixie Bright 101 and susceptible Bottom Special, were used. When about 2 inches in height, nine seedlings were transplanted into an aluminum pan, 8 by 8 by 2 inches, containing steam-sterilized sandy loam soil. The plants were inoculated when in the 4- to 5-leaf stage (approximately 6 inches in height) by flooding the pan with a mycelial suspension prepared by mixing 1/2 of a two-week-old oatmeal agar, Petri plate culture (approximately 30 ml. of medium per plate) in a Waring Blendor with 100 ml. of water. Following inoculation, the plants were held at greenhouse temperatures of 85° to 95° F. Daily counts of obviously diseased and dying plants were made following inoculation and used to compute a pathogenicity index for each isolate.

By use of this technique, isolates have been found to vary in pathogenicity from those which were weakly pathogenic on the susceptible Bottom Special to those highly pathogenic on the moderately resistant Dixie Bright 101 variety (Fig. 1). The range in variation in pathogenicity found among isolates obtained from burley tobacco has been similar to that observed among isolates from flue-cured tobacco. The approximately 160 isolates checked thus far on Dixie Bright 101 have been placed in arbitrary pathogenicity classes as follows: 39 percent with a

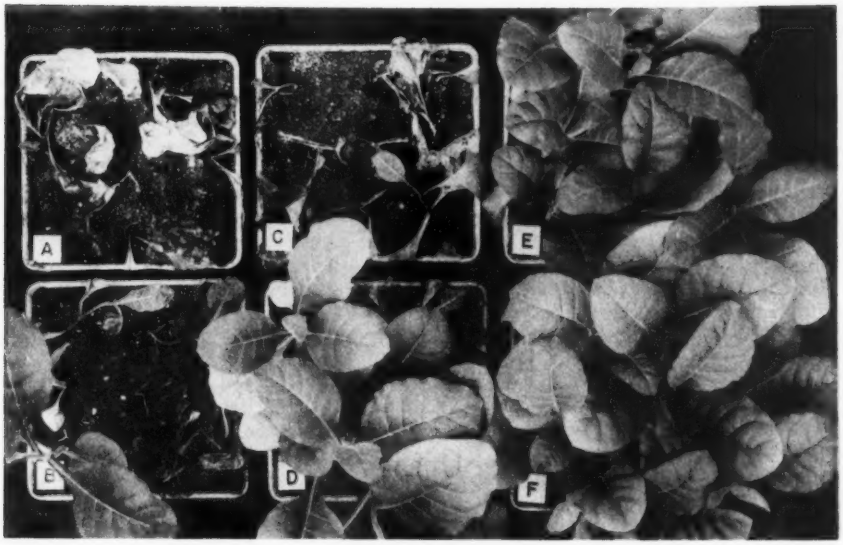

FIGURE 1. Differences in pathogenicity among three isolates of the black shank fungus on a susceptible and a resistant variety. Pans A, C, and E contain variety Bottom Special (susceptible), and B, D, and F contain Dixie Bright 101 (moderately resistant). A and B were inoculated with a highly pathogenic isolate; C and D were inoculated with a moderately pathogenic isolate; and E and F were inoculated with a weakly pathogenic isolate.

low pathogenicity index, 46 percent intermediate, and 15 percent high.

These findings were confirmed by inoculating larger plants. Both resistant and susceptible plants approximately 2 feet tall in 4-inch pots were inoculated by placing 30 grams of sterilized oat grain pure culture inoculum around the roots when the plants were transplanted to 8-inch pots. Care was taken during transplanting to avoid excessive root injury. Isolates which appeared to be weakly pathogenic when tested in pan inoculations were also weakly pathogenic when tested in this manner.

The preliminary results of this investigation indicate the existence of pathogenic strains of P. parasitica var. nicotianae. In general, it appears that the isolates collected from severe disease locations are among the highly pathogenic group. Thus, it is possible that this is one of the factors involved in many North Carolina fields where moderately resistant tobacco varieties fail to control black shank, especially in those areas where the population of plant parasitic nematodes is very low.

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EFFECTIVENESS OF CERTAIN SOIL FUNGICIDES IN THE CONTROL OF POTATO SCAB

G. V. C. Houghland and Lillian C. Cash

A direct approach to a possible solution of the potato scab problem can be made through the use of soil fungicides. However, this approach has certain limitations because a number of the fungicides that are likely to be effective against the causal organism frequently have been found to be toxic to potato plants, especially when used in the amounts that would be required for control. Applications of the fungicides prior to planting sometimes offset toxicity to the crop, but if this procedure appreciably delays planting many growers may object. The cost of some fungicides in relation to their rate of application and period of effectiveness is another item for consideration. Other considerations, such as ease of application and toxicity to humans, while the material is being applied and later through absorption by the potatoes, illustrate how complex the problem of scab control through use of soil fungicides can become.

1953 Experiment

A field at Beltsville, Maryland, thoroughly inoculated with Streptomyces scabies according to the procedure outlined by Houghland and Cash (2), was laid out in 1953 as a randomized-block experiment with 4-row plots, 47 feet long, replicated three times. The soil fungicides were applied broadcast to the entire plot area, but only the two center rows were harvested for plot records. Water emulsions of P-162 (hexachlorocyclopentadiene)[2] were applied with a small motor-driven sprayer equipped with a T-jet nozzle for hand application. Paraformaldehyde in flake form was applied broadcast by hand and sulfur was put on in finely ground form as "flowers". A gas mask was required while applying P-162 and paraformaldehyde. The land was disked twice immediately after the materials were applied. A volatile cloud of P-162 vapor could be seen rising from these plots before disking could be completed, indicating that apparently there was some loss of this material through volatilization. The Katahdin variety of potato was planted with a 1-row planter adjusted to apply 1,800 pounds of 5-10-5 fertilizer per acre in bands. The soil reaction at planting time was pH 5.0.

The results of this experiment are presented in Table 1. In general, the soil fungicides had no highly significant effects on yields except that yield on plots treated with 40 pounds of P-162 ten days before planting was low. This result is difficult to explain in view of the favorable yield obtained with 80 pounds of the same material. The time at which the paraformaldehyde and P-162 treatments were applied had no pronounced effect on the total yield or percentage of marketable potatoes as compared with that of the controls. Sulfur at both rates of application produced fewer scabby and more marketable potatoes than any of the other treatments. P-162 might have produced more beneficial effects if it had been applied so that the vapor could have been absorbed by the soil.

1954 Experiment

The field used in 1953 was reinoculated with Streptomyces scabies and used for the 1954 tests. The soil fungicides being tested were applied in the row mark at planting time, and all treatment plots were separated by untreated rows.

A new spray method was used to apply the water-soluble sodium orthophenylphenate (OPP). The spray solution of this material was delivered from a T-jet nozzle (No. 730616), which applied approximately 188 gallons per acre in a band 18 to 20 inches wide ahead of the planter and centered on the row mark. The nozzle was located at the front end of the tractor pulling the planter, and spray was applied at 100 pounds pressure from a reservoir and gear pump operated by the tractor power-takeoff. Thus spray was applied to the soil that the planter placed around the seed piece and in the ridge -- an ideal method of application. The sodium orthophenylphenate was dissolved at sufficient concentrations to give 50- and 100-pound applications under the conditions specified.

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[2] P-162 was very kindly supplied by the Shell Chemical Corporation, Denver, Colorado.

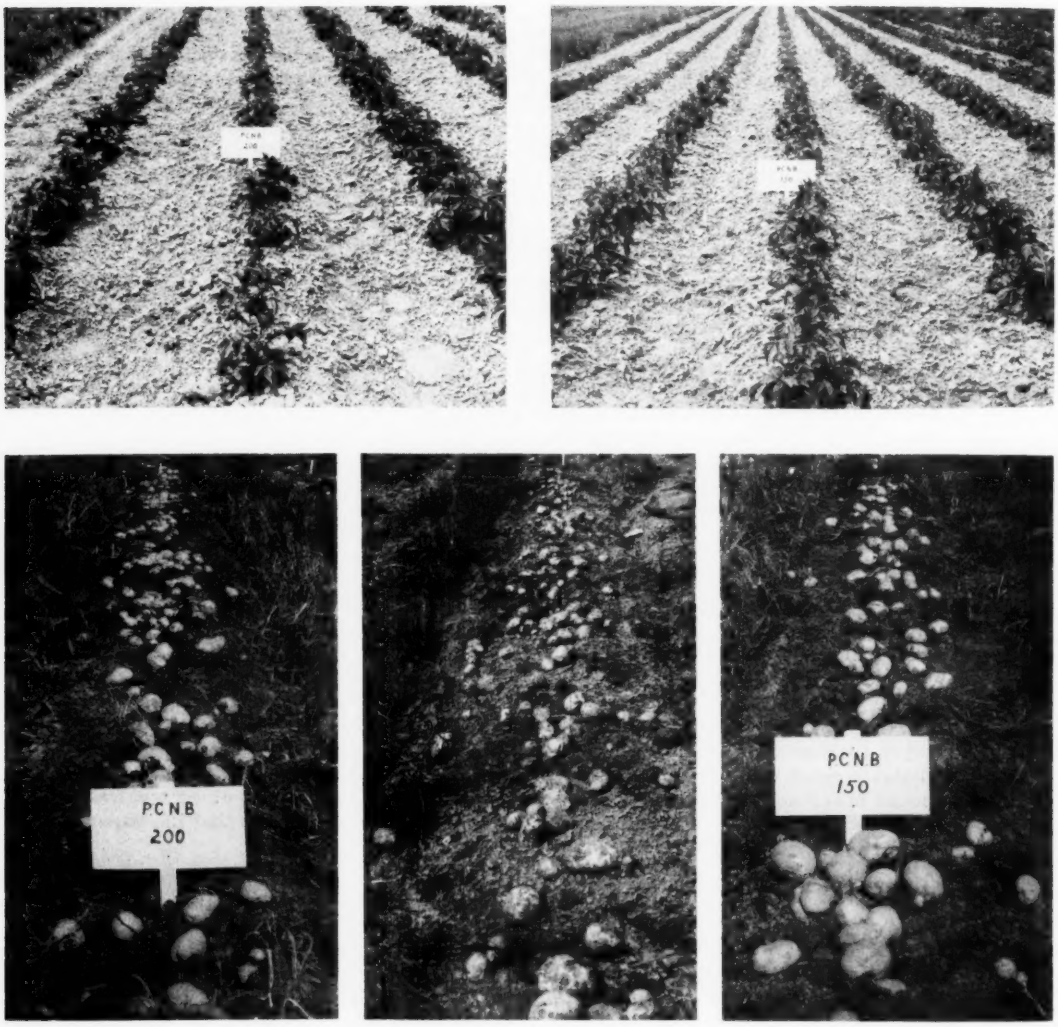

FIGURE 1

UPPER: Effects of PCNB on vine growth 44 days after planting. Left picture -- depressing effect on growth of 200 pounds per acre active ingredient compared with untreated rows, left and right. Right picture -- 150 pounds caused no effect on growth.

LOWER: Effects of PCNB on scab. Left picture, 200 pounds per acre active ingredient, and, right picture, 150 pounds, compared with, center picture, untreated.

Table 1. Effects of three soil fungicides tested in 1953 for control of potato scab.

Soil treatment	Amount of fungicide applied per acre	Total yield of tubers per acre	Marketable tubers per acre	Soil pH at harvesttime
	Lb.	Bu.	Pct.	
Sulfur, 10 days before planting	400	313.0	63.1	5.4
Sulfur, 10 days before planting	800	281.4	73.9	5.5
P-162, at planting	40[a]	282.6	61.8	6.0
P-162, 10 days before planting	40[a]	259.5	54.4	5.4
P-162, 10 days before planting	80[a]	307.6	45.3	6.0
Paraformaldehyde, at planting	250	297.5	41.5	5.7
Paraformaldehyde 10 days before planting	250	318.4	29.7	6.1
None (check)	--	301.8	44.0	5.8
L.S.D. (0.5% level)		35.0	Not sig.	

[a] Active ingredient.

Table 2. Effects of two soil fungicides tested in 1954 for control of potato scab.

Soil treatment lb. per acre	Marketable tubers per acre		Average difference from check of marketable tubers[a]	Scabby tubers per acre		Total yield per acre	Average yield per acre difference from check[a]	Soil reaction at planting time	Soil reaction at harvesttime
	Bu.	Pct.	Bu.	Bu.	Pct.	Bu.	Bu.	pH	pH
PCNB, 100	275.3	70.2	+193.0[c]	117.1	29.8	392.4	+10.4[d]	6.4	4.9
PCNB, 150	272.2	73.4	+189.9[c]	98.8	26.6	371.0	-10.9[d]	5.9	5.5
PCNB, 200	252.9	80.2	+170.6[c]	62.5	19.8	315.4	-66.5[c]	6.1	5.9
OPP, 50	141.6	35.1	+ 59.2[c]	261.3	64.9	402.9	+20.9[d]	5.9	5.3
OPP, 100	130.9	33.88	+ 48.6[b]	256.9	66.2	387.8	+ 5.8[d]	6.3	5.4
None (check)	82.3	21.5	--	299.7	78.5	382.0	--	6.2	6.0

[a] 6 paired comparisons.
[b] Significant
[c] Highly significant.
[d] Not significant.

It was originally planned to apply pentachloronitrobenzene (PCNB)[3] also as a spray. However, the material available was a 75% wettable powder, and it was found that the gear pump would not apply wettable powders without damage to the gears. Therefore, this material was mixed with sand and applied by hand in the row mark and then mixed with the surface soil. Katahdin potatoes were planted, and 1,800 pounds of 5-10-5 fertilizer were applied in bands.

The results of this test are given in Table 2. It is apparent that PCNB up to 200 pounds of active ingredient per acre was effective in reducing scab. However, the 200-pound rate produced a highly significant reduction in total yield (66.5 bushels) as compared with that on the untreated plot. The 200-pound rate also caused a very pronounced depression in early vine growth, illustrated in Figure 1. The reduction in yield and depression in vine growth are significant in view of the fact that Hooker (1) reported that the phytotoxic level was low and the yields on muck were not impaired by furrow applications of 2,000 pounds per acre of active ingredient. If Hooker used a 20% material he apparently applied 10,000 pounds of PCNB per acre in the row. In the present tests 267 pounds of 75% material applied in the row was toxic. Apparently the phytotoxicity of PCNB was very much greater under the present experimental conditions than it was when used on muck. However, no evidence of phytotoxicity was obtained at the 150-pound rate.

Although the increase in marketable potatoes, compared with no treatment, was highly significant for the 200-pound rate, the significant decrease in total yield and the depression in vine growth clearly indicate that the limits of safe application had been exceeded. Significant reductions in scab without appreciable effects on yield were obtained with the 100- and 150-pound rates. Further work needs to be done on the cumulative effects of these treatments on the same land over a period of years.

The OPP sprays had no effect on total yield, and although there was some indication that they reduced scab compared with no treatment, the percentages of scabby potatoes obtained (65 to 66 percent) were too high for this material to be considered effective as used.

Conclusions

PCNB showed considerable promise as an effective soil fungicide for the control of potato scab on upland soil. However, applications in the row above 150 pounds active ingredient per acre apparently were phytotoxic to potatoes and therefore more work should be done on preplanting applications at these rates. Information is also needed on the cumulative effects of successive applications of this material.

Sodium orthophenylphenate solutions sprayed on the soil ahead of the planter had no effect on potato yields, but the material as used was not effective in control of potato scab.

Paraformaldehyde was not effective as a soil fumigant for controlling potato scab, and the test with P-162 was inconclusive because much of the vapor was lost from the soil directly after application. Further tests will be made with this water-soluble material applied as a spray ahead of the planter. Sulfur reduced the percentage of scabby potatoes, 400 pounds per acre being almost as effective as 800 pounds, but it was not so effective as PCNB in reducing the percentage of scab.

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[3] The pentachloronitrobenzene was kindly supplied by Mathieson Chemical Corporation, Baltimore, Maryland.

A CERCOSPORA ON WINTER PEA

W. W. Hare

Weimer in 1941 (1) recorded the occurrence of Cercospora lathyrina Ell. & Ev. on Austrian Winter and similar types of pea (Pisum spp.) growing under a cheesecloth shelter at Experiment, Georgia. It had been observed in September 1938, and in following summers. He pointed out that the disease had never been seen in the field and was not known to be of any economic importance.

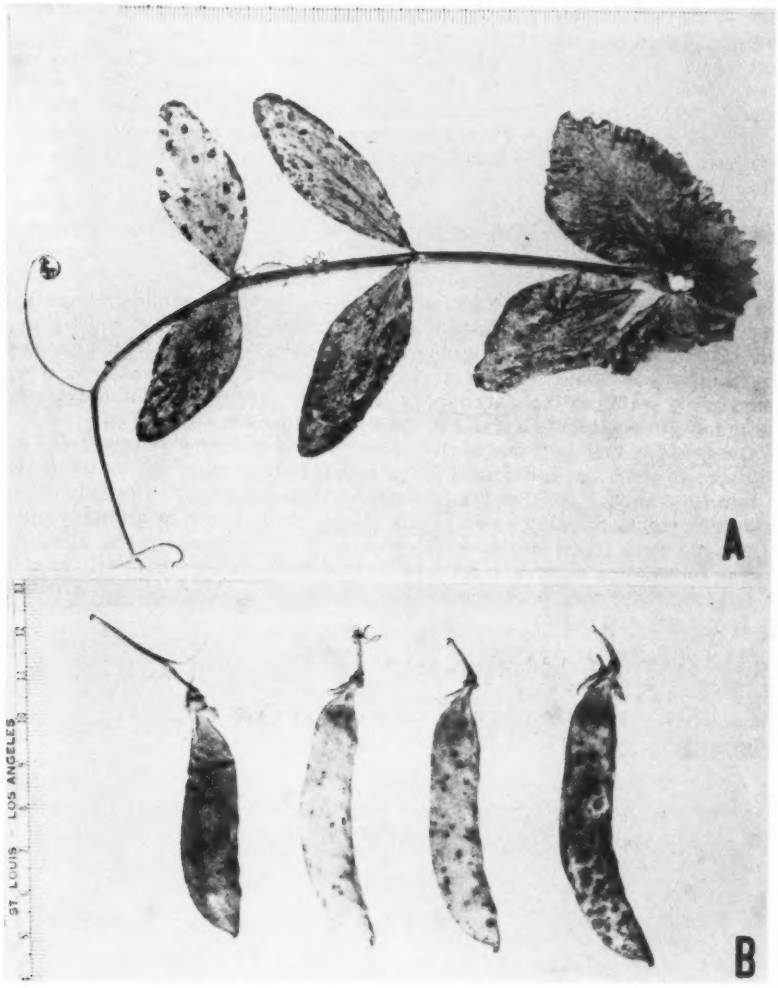

FIGURE 1. Cercospora on a strain of winter pea. A, leaf; B, green pod to left, three dry pods to right showing variations in number and size of lesions.

This is to report the observation of what appears to be the same disease in the field. A four-acre field of a breeding strain of Austrian Winter type planted October 7, 1953, at the Coastal Plain Branch Experiment Station near Newton, Mississippi, was noted as having a minor leaf spot in localized areas on February 17, 1954. On March 16 there had been little or no spread from these areas to surrounding plants and upon closer examination all affected plants were in low parts of the field where water had stood after rains. There was little further change by April 5. The disease had progressed up to higher leaves on infected plants with very little spread to other plants.

On inspection May 1, the disease was general over the field and striking in appearance. It was very similar to severe attacks by Ascochyta. Individual plants had numerous spots on the leaves (Figure 1, A), stems, and pods up to near the top of the plants. Specimens were taken to the laboratory, placed in a moist chamber, and examined two days later. Cercospora spores were abundant on the lesions and no other fungi, other than scattered Alternaria and Penicillium, were observed. Single spore isolations of the Cercospora produced cultures very similar to other Cercospora spp. on hand. Comparison of the symptoms to Weimer's description of the symptoms produced by C. lathyrina (1) agreed closely. He did not describe the disease on pods. On young pods lesions were inconspicuous, varying from pinpoint flecks to very small brown lesions. These enlarged slightly, up to 1-2 mm. in diameter, as the pod reached full size and occasionally one showed a grey center. As the pods matured, dried, and the green color faded, the lesions became conspicuous. They enlarged, often up to 5-8 mm. in diameter, into black, felty patches of mycelium (Figure 1, B). Numerous lesions produced a black cast of the entire pod as they coalesced.

The field was examined again on May 20 as the crop was approaching maturity. All of the plants had dry leaves and pods at least halfway up the stem and were in varying degrees of maturity from that to many plants completely dry. Powdery mildew had appeared and covered all of the remaining green tissue. Other than on the matured pods and stems, it was difficult to find a recognizable lesion of the Cercospora leaf spot. Apparently the heavily infected leaves had dried and there had been little spread to the new top growth since May 1.

Since no Cercospora leaf spot had been observed on peas in the field before, and none appeared in plots grown from the same seed lot at several other locations in the State, a search was made in this field and adjacent areas for other winter legumes.. The only other legume found was volunteer plants of hairy vetch (Vicia villosa Roth.) both in the field and around the edges. Leaf lesions were found on the vetch containing Cercospora spores similar to those found on the pea, in addition to severe disease incited by Colletotrichum villosum Weimer.

Further work is under way to determine the identity of the Cercospora isolated, and if it is pathogenic to the pea and vetch.

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XANTHOMONAS PRUNI IN SUMMER CANKERS ON PEACH IN SOUTH CAROLINA[1]

H. H. Foster and D. H. Petersen

From the descriptions of bacterial spot cankers by early investigators, it would appear that Xanthomonas pruni, the causal organism, was in some instances isolated from overwintered cankers that had produced visible lesions on green succulent shoots during the preceding summer. These cankers have been called "summer cankers" to distinguish them from others called "spring cankers" that do not produce macroscopic symptoms until the following year even

FIGURE 1. Overwintered summer canker (enlarged). Note dead, ash colored tissue with crack near center of canker. Also watersoaked area (indicating the presence of bacteria) in living tissue joining the dead canker tissue.

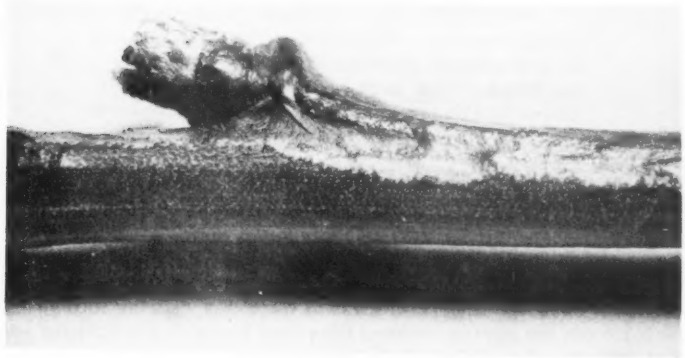

FIGURE 2. An internodal spring canker (enlarged). Note depressed flattened area on both sides of developing bud.

[1] The illustrations were prepared by L. W. Riley, Extension Specialist, Motion Pictures and Photography, Clemson College.

FIGURE 3. Spring cankers (enlarged). developing at or near terminal buds (A, B, and C) and extending for a limited distance down the twigs. Note dark-colored to black canker tissue and constricted zone at base of cankers.

though they were initiated by infections late in the preceding summer. The term black tip canker is generally considered to be synonomous with one type of spring canker. Thornberry and Anderson in Illinois (5), apparently the first to use the terms spring and summer cankers, were unable to prove survival of X. pruni in summer cankers. In recent years, several reports (1, 2, 3, 4) have included information concerning the spring or black tip canker. Under South Carolina conditions the writers consider that most of the early, spring foliage infection is initiated by bacteria oozing from the spring cankers observed early in the current season. However, under certain conditions, it is believed that bacteria overwintering in the summer cankers may be important in inciting infection of spring foliage. The purpose of this article is to report the occurrence of viable bacteria during late winter in summer cankers.

Severe foliage symptoms, typical of bacterial spot, were observed in an orchard of 3-year-old Jerseyland peach trees during the summer of 1952. Summer cankers were particularly numerous on the water sprouts developing in the centers of the trees. Macroscopic symptoms were first observed in June and additional cankers were noted in July and August. All the cankers seen were internodal.

On January 27, 1953, collections were made of several of the overwintered summer cankers (Fig. 1), as well as a number of the typical spring cankers (Figs. 2, 3) developing at that time. Most of the spring cankers observed at the time of collection were in the early macro-

scopic stage and extremely difficult to locate and identify. A few of these cankers undoubtedly could have been discerned a few weeks prior to January 27. Several isolations were attempted from both types of cankers. Relatively few bacterial colonies were obtained, but following repeated transfers on nutrient agar at approximately 24° C. the bacteria showed an increase in vigor and rate of growth. Under greenhouse conditions, isolates from both the summer cankers and the spring cankers induced macroscopic symptoms of bacterial spot on peach foliage within six days after inoculation.

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YELLOW-POPLAR DIEBACK

E. Richard Toole[1] and B. J. Huckenpahler[2]

In 1953 the authors found an apparently new disease of yellow-poplar (Liriodendron tulipifera L.) causing dieback and mortality in one small area of sapling trees on the Tallahatchie Experimental Forest near Oxford, Mississippi. Because of the importance of this species in forestry and its relative freedom from damaging diseases, preliminary studies of the dieback were inaugurated. In early 1954 additional reports of this disease were received from other areas in Mississippi, and it was found to be more widespread on the Tallahatchie Experimental Forest than previously supposed.

In 1953, an observation plot of 35 diseased trees was established near Oxford. One year later, 17 of the trees were definitely worse. None of them had died, but considerable mortality was found associated with this disease in other stands in 1954.

This paper describes the symptoms and etiology of the disease as we know it.

Symptoms

The dieback first becomes noticeable when the leaves at the ends of the branches in the upper crown appear dwarfed and chlorotic; usually a few dead twigs are also scattered throughout the crown (Fig. 1, A).

Later, more branches die from the top down and sprouts are often produced at the base of the killed branches (Fig. 1, B). Sometimes the dieback progresses rapidly until the entire tree is killed. In other cases the dieback spreads slowly, killing 10 or 20 percent of the crown in one year.

Close examination of the crowns of diseased trees reveals that the branches die back to varying degrees. There is usually a definite line of demarcation between the living and dead tissue (Fig. 1, C). It is common to find that the dieback has spread from a smaller branch into a larger one, as evidenced by the dead areas surrounding the base of the smaller branch in Figure 1, D. A species of Myxosporium was found fruiting on some recently killed twigs in 1954.

Etiology

A fungus as yet unidentified was consistently isolated from the margin between living and dead tissue of diseased twigs in 1953 and again in 1954. The pathogenicity of this fungus was tested in 1953 by wound inoculations of yellow-poplar saplings 1 to 4 inches in diameter at breast height. The surface of the smooth bark of the boles was sterilized with alcohol, after which an incision was made through the bark with a sterile knife and bits of mycelium from an agar culture of the fungus were placed in the wound. The wound was then covered with damp cotton held in place with drafting tape. Checks were made in the same manner except that sterile agar was used in place of the fungus.

Twenty-four inoculations and 25 checks were made. Nine months after inoculation, cankers 3 to 6 inches long were found around 75 percent of the inoculated wounds (Fig. 1, E). All of the check wounds had healed over with no canker formation. The fungus used as inoculum was reisolated from one canker which was removed from the experiment. The other cankers were left undisturbed in order that their future enlargement could be determined.

Discussion

Inoculation with the fungus consistently isolated from yellow-poplar dieback will produce sizeable lesions in less than a year. Since this fungus has not sporulated in culture, it is not known at present whether it is identical with the Myxosporium found fruiting on the dead bark

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1 Stationed at Delta Research Center, Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture. The Delta Research Center is maintained in cooperation with the Mississippi Agricultural Experiment Station at Stoneville, Mississippi, and is partially financed by the Southern Hardwood Forest Research Group.

2 Stationed at Tallahatchie Research Center, Southern Forest Experiment Station, maintained at Oxford, Mississippi, in cooperation with the University of Mississippi.

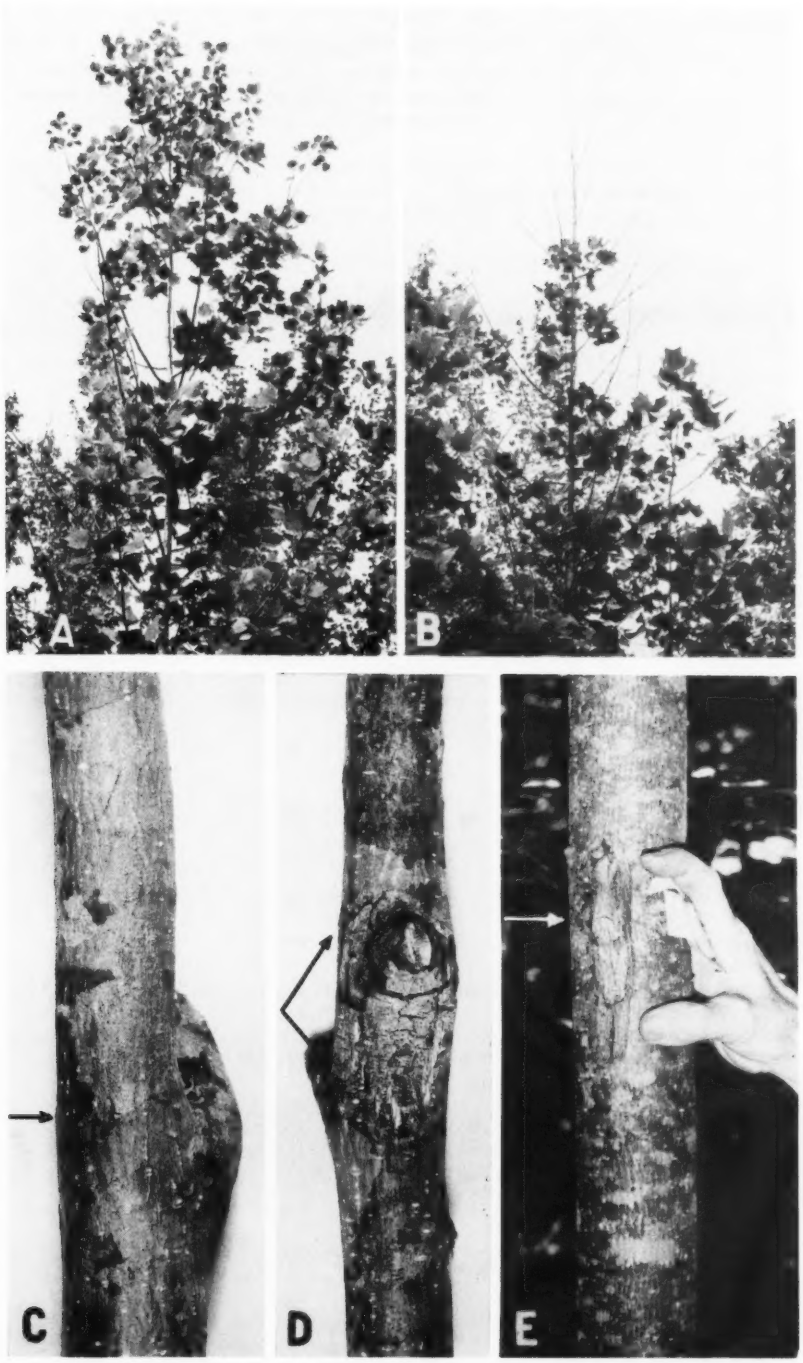

FIGURE 1. Yellow-poplar dieback. A: Early stage. Note the dwarfed foliage in the upper crown and the scattered dead twigs. B: Advanced dieback. Most of the upper crown is dead with a few sprouts along the main stem. C: Dieback as it appears on the branches. The arrow indicates the margin between living and dead tissue. D: Dieback has progressed down the small branch and produced a canker on the larger one as indicated by the arrows. E: Canker resulting from inoculation nine months before the photograph was taken. The point of inoculation is opposite the arrow and the length of the canker is indicated by the hand.

of some diseased twigs.

The limited known distribution of the dieback makes evaluation difficult. It is perhaps important that the disease first attracted our attention after several severe drought years had occurred in the area. Possibly the fungus is always present in the forest and has built up to the present situation on trees somewhat weakened by the recent drought cycle.

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HOST RANGE OF THE RHIZOCTONIA AERIAL BLIGHT FUNGUS IN LOUISIANA

W. H. Stroube

A foliage disease referred to as "aerial blight" or "summer blight" has been observed on a number of economic and wild plants in Louisiana in recent years and has caused considerable damage to some forage and hay crops in the State. The causal organism has been identified as a "sasakii" type of Rhizoctonia, which according to Exner[1] is Pellicularia filamentosa (Pat.) Rog. forma sasakii (Shir.) Exner.

Table 1 includes the plants on which the disease was found to occur naturally in Louisiana.

Table 1. Plants on which natural infection by Pellicularia filamentosa f. sasakii has been found in Louisiana.

Latin binomial	Common name or variety
Alopecurus carolinianus Walt.	Foxtail
Alternanthera philoxeroides (Mast.) Griseb.	Alligator Weed
Alsicarpus vaginalis (Neck.) DC.	Alyce clover
Ambrosia artemisiifolia L.	Ragweed (Common)
Ambrosia trifida L.	Ragweed (Giant)
Axonopus affinis Chase.	Carpetgrass
Bromus catharticus Vahl.	Rescuegrass
Bromus inermis L.	Smooth brome
Bromus secalinus L.	Cheat
Cynodon dactylon (L.) Pers.	Bermuda grass
Cyperus rotundus L.	Nutgrass
Digitaria spp.	Crabgrass
Eleusine indica (L.) Gaertn.	Goosegrass
Erigeron philadelphicus L.	
Festuca arundinacea Schub.	Tall fescue
Geranium carolinianum L.	Wild Geranium
Glycine max (L.) Merr.	Soybean
Lepidium virginicum L.	Peppergrass
Lotus corniculatus L.	Birdsfoot trefoil
Lespedeza bicolor Terez.	
Lespedeza cuneata (Dumont) Don.	Sericea Lespedeza
Lespedeza stipulacea Maxim.	Korean Lespedeza
Lespedeza striata (Thunb.) H. & A.	Common Lespedeza
Lespedeza striata (Thunb.) H. & A.	Kobe Lespedeza
Medicago arabica L.	Spotted bur clover
Medicago hispida Gaertn.	Bur clover
Medicago lupulina L.	Black medic
Muhlenbergia schreberi J. F. Gmel.	Nimblewill
Oryza sativa L.	Rice
Panicum spp.	
Paspalum spp.	
Phalaris arundinacea L.	Reed Canarygrass
Phalaris canariensis L.	Canary grass
Phalaris caroliniana Walt.	
Phalaris minor Retz.	
Solanum carolinense L.	Horse nettle
Solidago spp.	Goldenrod
Sorghum halepense (L.) Pers.	Johnsongrass
Stellaria media (L.) Cyrill.	Chickweed (Common)

[1] Exner, Beatrice. 1953. Comparative studies of four Rhizoctonia occurring in Louisiana. Mycologia 45: 698-719.

Table 1 (continued).

Latin binomial	Common name or variety
Trifolium agrarium L.	Hop clover
Trifolium pratense L.	Red clover
Trifolium repens L.	White clover
Xanthium chinense Mill.	Cocklebur

Table 2 includes some additional cultivated plants found to be highly susceptible to the disease under greenhouse conditions. Inoculation was accomplished by using dried oat inoculum applied to the foliage of the test plant. The plants were placed in a moist chamber at 28° C. for 36 hours following inoculation, then removed, and placed on a greenhouse bench. Disease severity ratings were made 24 hours later.

Table 2. Plants successfully inoculated with Pellicularia filamentosa f. sasakii.

Latin binomial	Common name or variety
Avena spp.	Oats
Dactylis glomerata L.	Orchardgrass
Lathyrus hirsutus L.	Singletary pea
Medicago sativa L.	Alfalfa
Pisum arvense L.	Dixie Wonder pea
Pisum sativum L.	Creole pea
Trifolium incarnatum L.	Crimson clover
Triticum sativum L.	Wheat
Vicia benghalensis L.	Purple vetch
Vicia sativa L.	Common vetch
Vicia villosa Roth.	Hairy vetch

Of all plants tested, only Dallisgrass (Paspalum dilatatum Poir.), rice (Oryza sativa L.), and rye (Secale cereale L.) showed a measurable degree of resistance under the greenhouse conditions previously described.

DEPARTMENT OF BOTANY, BACTERIOLOGY AND PLANT PATHOLOGY, LOUISIANA AGRICULTURAL EXPERIMENT STATION, LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA

INFECTION OF EGGPLANT, SOLANUM MELONGENA, BY THE GOLDEN NEMATODE OF POTATOES, HETERODERA ROSTOCHIENSIS

George Fassuliotis and Julius Feldmesser[1]

All previous investigations on the host range of the golden nematode of potatoes, Heterodera rostochiensis Wollenweber, 1923, both in Europe and in the United States have shown that potatoes and tomatoes are the only commercially important crop plants on which this nematode can complete its life cycle. In the summer of 1952 the present work was begun to determine the susceptibility of crop plants other than potato and tomato, grown commercially on Long Island, New York. Leachings from 16 crop plants were tested for their ability to stimulate hatching of the nematode larvae[2]. Among these, only leachings from eggplant showed a hatching rate comparable to that of potato root leachings; those from the other plants showed no significant differences from tap water.

In further tests to compare the activity of eggplant-root leachings with potato-root leachings, batches of cyst material containing approximately 200 to 400 cysts of H. rostochiensis in each replication were exposed to leachings from eggplant and potato roots for 4, 7, and 21 days in separate tests. Tap water was used as a control. The larvae and the cysts in each test were counted at the end of the exposure period; results of the counts are expressed as numbers of larvae per cyst in Table 1. The rates of hatching of the larvae from cysts maintained in eggplant-root leachings and potato-root leachings did not differ significantly. Emergence in the tap water controls was low.

Further tests were made, using growing plants instead of root leachings. One eggplant seedling was planted in golden-nematode-infested soil in each of five 6-inch pots and grown under greenhouse conditions. Periodically, over a period of 66 days, the soil balls were removed from the pots and examined for developing H. rostochiensis females, according to the method of Mai (1951). Entire root systems were also fixed in a Flemming's chrom-osmo-acetic acid mixture after 38, 52, and 66 days. Macroscopic examination of the soil balls revealed no developing females. However, microscopic examination of the roots after fixation showed a total of more than 100 second-stage and third-stage larvae in each of three plants fixed. In addition, one saccate fourth-stage female in situ was found in the 38 and 66 day old roots. Previously, Mai and Lownsbery (1948) reported no infection of eggplant roots grown in infested soil.

As a result of finding the fourth-stage females on the roots, and of establishing a lack of significant difference of hatching rates of larvae between eggplant-root leachings and potato-root leachings, further infection tests were carried out on eggplant. On November 13, 1953 each of ten eggplant seedlings growing in 4-inch pots of sterile nematode-free soil were inoculated with 10,000 golden nematode larvae. Holes were punched in the soil around the stem of the plant and the larvae were introduced into them with a pipette. On December 9 three or four fourth-stage developing females were observed on the outside of the roots of each plant. Soil washings from one of these plants also revealed 40 males. By December 28 the cysts on the periphery of the root systems of all of the remaining nine plants had turned yellow. Some of the females removed from the roots were found to contain embryonated eggs in various stages of development. Golden brown cysts containing second-stage larvae within the eggs were recovered from the roots of all plants on January 4. The number of cysts on four of these potted eggplants was counted: an average of 55 cysts per plant was found. Thirty-six of these cysts were opened under the binocular dissecting microscope. The number of eggs per cyst ranged from 26 to 274 with a mean of 95, a standard error of $\pm$ 10, and a coefficient of variability of 60%.

Measurements were taken of these "eggplant cysts" and their contents for any possible morphological differences between these and the "potato cysts" (Table 2).

From the results of these experiments it can be concluded that eggplant should be considered an important factor in the biology of the golden nematode of potatoes. Hatching and emergence of infective larvae has been demonstrated to occur, when cysts are exposed to eggplant-

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[1] Junior Nematologist and Nematologist, respectively, United States Department of Agriculture, Agricultural Research Service, Hicksville, Long Island, New York.

[2] Celeriac, celery, fennel, cauliflower, broccoli, kohlrabi, collard, kale, cabbage, pepper, string beans, lima beans, spinach, okra, escarole and eggplant.

Table 1. Number of golden nematode larvae hatched from cysts after 4, 7, and 21 days' exposure to potato-root leachings, eggplant-root leachings, and tap water controls. Hatching is expressed in numbers of larvae per cyst.

Medium	Number of larvae after indicated length of exposure					
	4 days		7 days		21 days	
	Number of replications	Larvae per cyst	Number of replications	Larvae per cyst	Number of replications	Larvae per cyst
Potato leachings	4	5.81	10	4.80	3	10.94
Eggplant leachings	10	4.18	10	4.46	3	9.03
Tap water	3	0.16	5	0.19	3	1.36

Table 2. Dimensions of Heterodera rostochiensis grown on eggplant, Solanum melongena.

Stage	Number measured	Range (microns)	Mean[a] (microns)	Coefficient of variability (percent)
Cysts				
Length[b]	35	388-667	539 ± 12	13
Width	35	233-543	371 ± 13	21
Eggs				
Length	34	92-114	105 ± 0.7	0.7
Width	34	43-58	50 ± 0.6	1.3
Larvae[c]				
Length	94	357-496	431 ± 3.8	0.9
Width	94	18-33	21 ± 0.1	0.3
Stylet	95	20-25	23 ± 0.1	0.5
Tail	92	17-30	24 ± 0.4	1.5

[a] Mean ± standard error.

[b] Includes neck of cyst.

[c] Obtained by rupturing egg shell with slight pressure of a blunt needle.

root leachings, and when the cysts are in soil containing growing eggplant roots. The complete cycle of growth and reproduction has occurred on embryonated eggs being found after 45 days and second-stage larvae being found after 52 days, subsequent to exposure to second-stage infective larvae.

The dimensions of these cysts, eggs and larvae all fall within the ranges reported by Franklin (1951). Furthermore, all of these stages (cysts, eggs and larvae) grown on eggplant showed no morphological differences from the corresponding stages grown on potato. These data show that the golden nematode of potatoes once previously thought to complete its life cycle only on potato or tomato, can also attack, and complete its life cycle on, another commercial crop, eggplant.

Literature Cited

1. Franklin, M. T., 1951. The cyst-forming species of Heterodera.

Commonwealth Agric. Bur., England, 147 pp.

2. Mai, W. F., 1951. Solanum Xanti Gray and Solanum integrifolium Poir., new hosts of the golden nematode, Heterodera rostochiensis Wollenweber. Amer. Potato Jour. 28: 578-579.
3. _____, and B. F. Lownsbery. 1948. Studies on the host range of the golden nematode of potatoes, Heterodera rostochiensis Wollenweber. Amer. Potato Jour. 25: 290-294.

NEMATOLOGY SECTION, HICKSVILLE, LONG ISLAND, NEW YORK

AN INCUBATION METHOD FOR COLLECTING MIGRATORY ENDO-PARASITIC NEMATODES

T. W. Young

The Baermann funnel method (Goodey[1]) is widely used for collecting nematodes from plant material. However, a large percentage of the nematodes which emerged from avocado roots did not settle in the stem of the funnel where they could be drawn off in a small volume of water. A series of tests were conducted in order to estimate the percentage of emerging nematodes actually obtained by this method. Individual tests were made with the burrowing nematode, Radopholus similis (Cobb) Thorne, and with meadow nematodes, Pratylenchus sp. Filipjev.

Active nematodes in known numbers, from 50 to 100, were placed in the muslin bag in a funnel filled with clean water. After one day, sampling was started and repeated for several days. Total recovery ranged from a few to approximately one-third of the specimens in the funnel. Even when all the water in the funnel was drawn off rapidly, defeating the purpose of the method, the recovery was never over 75 percent. By back flushing with a wash bottle, many nematodes were found to remain in the sack as well as on the sloping walls of the funnel. With this broad variation and low recovery, the method leaves much to be desired, especially where one is concerned with following population trends.

An efficient and more rapid method than the Baermann funnel technique has been developed for extracting burrowing and meadow nematodes from avocado roots. In this method, living roots up to about 1/4 inch in diameter, preferably unsuberized young roots, are collected in a covered container with a small amount of water, moist paper or cloth in the bottom to maintain a humid atmosphere. Caution must be exercised not to expose the roots to high temperatures; all stages of the worms are killed at around 110° F. for three hours.

At the laboratory the roots are washed thoroughly to free them of soil and foreign organic matter by several immersions in clean water or by hosing with moderate pressure. They are then placed in Mason jars in moist condition and incubated at room tempeature. Within a few hours at most, nematodes start accumulating with the small amount of water draining from the roots to the bottom of the jar. These nematodes are then poured directly into a Syracuse watch-glass for identifying and isolating. As the water in the jar is exhausted by sampling, it is replaced by an occasional spraying with a wash bottle. This also moistens the roots and brings down additional nematodes. Over 3,000 burrowing nematodes were isolated from a pint of loosely packed avocado roots in a two-week period by this method. Comparable results were obtained with meadow nematodes.

Algae and molds sometimes tend to cloud the water after a time and interfere with identification. This trouble can be minimized by adding only enough water to the cultures for readings to be made within the next several hours. When the cultures are to stand idle for a day or more, moisten the roots so that there is practically no drainage. If the cultures become contaminated to the point of uselessness they can be cleared somewhat by flushing the jars several times with large volumes of water. The used wash-water can be run through the sieve-Baermann funnel process to recover nematodes flushed from the roots and jar.

Some idea of the relative efficiency of the Baermann funnel and the incubation method of collecting nematodes was secured by halving 14 composited samples of roots from various locations. One portion of each sample was placed in funnels and the remainder incubated in a jar. The nematodes were drawn off periodically until the yield of burrowing and meadow nematodes, which were counted, had practically ceased. With a few exceptions, the yield of these nematodes was much less from the funnels than from the jars. The total yield of burrowing nematodes from the 14 samples in funnels was 805 as compared with 3,761 from the jars. Similar results were secured for meadow nematodes.

The number of nematodes varies greatly in different roots from the same location or even in adjacent sections of the same root. For this reason, it is difficult to divide samples so the portions are truly comparable with respect to nematode populations. A larger number of samples than used here probably would be necessary for a more accurate comparison. But since nearly five times as many nematodes were collected by the proposed method as by the standard, the yield doubtlessly would average considerably larger by incubation, because of retention of nematodes in the funnel in more critical comparative tests.

Incubation requires less equipment and less of the operator's time than the Baermann

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[1] Goodey, T. Soil and freshwater nematodes. John Wiley and Sons, Inc. New York. 1951.

Florida Agricultural Experiment Station, Journal Series, No. 290.

method. Because of the rapidity with which nematodes can be collected in relatively large numbers by this method, incubation is convenient for isolating migratory endo-parasitic species for inoculation in pure culture. By using weighed samples of roots, selected for age and diameter range, this method is suited to following population trends of migratory endo-parasitic nematodes. With modification, perhaps, it can be adapted to crops other than avocados.

UNIVERSITY OF FLORIDA, SUB-TROPICAL EXPERIMENT STATION, HOMESTEAD, FLORIDA

NEW RECORDS OF PLANT DISEASES

CURVULARIA DISEASE OF GLADIOLUS IN CALIFORNIA

By J. G. Bald and Brian B. Markley

The discovery of Curvularia lunata Boed. as a disease of major importance in Florida and Alabama in 1947 caused apprehension among growers in California. Since this time a watch for the disease has been kept in California gladiolus growing areas, but it has not been seen until recently. Twice during the last year it has been found in gladiolus plantings; once in San Diego County and once in Alameda County. In each instance it took the form of a neck rot of cormel stock, but in neither instance was of serious consequence. In one case it was secondary in importance to Fusarium disease. The organism was isolated in pure culture and inoculated on healthy gladiolus plants. The same organism was reisolated in pure culture. The isolates were characteristic of the species, C. lunata Boed. The possibility that Curvularia will cause a major disease in California appears remote. The combination of high temperature and high humidity which provides favorable conditions for the disease seldom occurs during any extended period in the gladiolus-growing areas.

DEPARTMENT OF PLANT PATHOLOGY, UNIVERSITY OF CALIFORNIA, LOS ANGELES 24.

PIRICULARIA ORYZAE ON EREMOCHLOA OPHIUROIDES IN FLORIDA

By T. W. Johnson, Jr.

Piricularia oryzae Br. & Cav. is not limited in host range to varieties of rice. Under the binomial Piricularia grisea, the fungus has been identified as a parasite of such grasses as Echinochloa crus-galli, Digitaria sanguinalis, and Stenotaphrum secundatum. Isolates from these hosts are slightly to moderately pathogenic to such rice varieties as Caloro and Colusa. De Gutiérrez (Plant Dis. Reptr. 38(9): 695, 1954) found the fungus naturally parasitic on sugar cane in Costa Rica.

Recently, Piricularia oryzae (= P. grisea) was isolated from lesions on leaves of Eremochloa ophiuroides (centipede grass) in Alachua County, Florida, near Gainesville, and in Leon County, near Tallahassee. Judging from the literature, the fungus has not previously been reported from this host in the United States. Macroscopically, the lesions are 1-3 mm. long by 1-1.5 mm. in diameter, with a gray center bordered by a light-brown, necrotic margin. Except for size, lesions caused by P. oryzae may easily be mistaken for anthracnose of centipede grass (Colletotrichum graminicola). Simple or sparingly-branched conidiophores bearing 1- to 3-celled, citriform conidia are produced on the lesions when infected leaves are incubated in damp chambers. Measurements of these conidia are in close agreement with those recorded for P. oryzae. Infection on Eremochloa was found only in mixed stands of centipede and St. Augustine grass where the latter was moderately infected by Piricularia. Even in such stands, centipede grass commonly bore only one to five lesions per plant, suggesting some resistance to the disease.

Specimens have been deposited in the mycological collections, Duke University.

DEPARTMENT OF BOTANY, DUKE UNIVERSITY, DURHAM, NORTH CAROLINA

STRAWBERRY FRUIT ROT IN MAINE CAUSED BY GNOMONIA FRUCTICOLA

By Donald Folsom

In early July a high percentage of green, ripening, and ripe fruits in a Maine plantation of strawberries were more or less decayed. Botrytis was evident on some fruits, but most of a series of isolations from other decayed fruits yielded pure cultures of a different kind of fungus. Several of these cultures produced pycnidia of Zythia fragariae Laibach, and one produced perithecia of Gnomonia fructicola (Arnaud) Fall, as described by Fall (3). This is of interest in view of the statements by Fall that Zythia fragariae had not been reported previously for North America, and that except for a paper by Alexopoulos and Cation (1) no previous reference to Gnomonia sp. on strawberry had been found in the North American literature.

Studies by Alexopoulos and Cation (1, 2) in Michigan refer to stem-end rot and soft rot as

typical of this disease. In addition to isolations of the fungus from these types of rot, the writer secured some isolations from lesions on the side of the fruit. No foliage disease was noted except the common Mycosphaerella leaf spot. Leaf blight, caused by Dendrophoma obscurans (Ell. & Ev.) H. W. And., has been identified in Maine once, in 1953. Fall states that Gnonomia fructicola does not appear to be highly parasitic on the leaves.

MAINE AGRICULTURAL EXPERIMENT STATION

[1] Alexopoulos, Const. J., and Donald Cation. 1952. Gnomonia fragariae in Michigan. Mycologia 44: 221-223.

[2] _____. 1948. Stem-end rot of strawberries. Phytopath. 38: 698-706.

[3] Fall, Joan. 1951. Studies on fungus parasites of strawberry leaves in Ontario. Can. Jour. Bot. 29: 299-315.

SOME CORRECTIONS

PHYSIOLOGIC RACES OF PUCCINIA RUBIGO-VERA TRITICI: In the article entitled "Physiologic Races of Puccinia rubigo-vera tritici in the United States in 1953," by Johnston and Levine, Plant Disease Reporter, Vol. 38(9): 647, last paragraph, change the word "major" to "minor". The sentence should read: The distribution and prevalence of the 14 minor races is shown in Table 2.

EFFECT OF CANDICIDIN ON PLANT PATHOGENIC FUNGI: In Table 1 of the article by Alcorn and Ark in the Reporter for October 15, on page 706, the correct order of concentrations should be 1:10,000; 1:20,000; 1:40,000; 1:80,000; 1:100,000; 1:200,000; 1:400,000 and 1:800,000; -- instead of 1:100,000; 1:200,000; 1:400,000; 1:800,000; 1:10,000; 1:20,000; 1:40,000; 1:80,000.

MYCOLOGICAL NOMENCLATURE AND THE 8th INTERNATIONAL BOTANICAL CONGRESS

John A. Stevenson

The International Code of Botanical Nomenclature, based on the decisions of the nomenclature section of the 7th International Botanical Congress at Stockholm in 1950, did not become available until a relatively short time before the 8th Congress at Paris.

It was the expressed hope of the editors that the Code would have a thorough workout before attempts were made to modify or rework it. However, even in the brief period before the opening of the Paris Congress over 400 proposals were formally presented for modifications, deletions, and additions, ranging from a plan for an almost complete rearranging and rewriting of the code to changes of a word or two in various articles or recommendations. This situation necessitated seven half-day sessions of the Nomenclature Section during the period June 28-July 1, preceding the convening of the Congress itself.

Of the more than 400 proposals, approximately 225 were rejected, 90 were accepted, often in amended form, and the balance were referred to the editorial or other special committees with power to act. Although no major proposals involving rejection of old established principles or the adoption of new ones were accepted, a sufficient number of changes were approved so that a new edition of the Code will be necessary. This should be ready soon. The new edition was authorized to be published in English and French, with the proviso that in case of doubt over any of the wording, the English version should prevail. German and Spanish editions were also authorized if interest was sufficient to warrant translation.

Proposals directly affecting fungus nomenclature were few, but several that were presented to the Section would have been far-reaching in effect if adopted.

It was proposed to amend Section 21 as follows "up to and including 31 Dec. 1954 the type may be a figure and/or a description for plants of which no type specimen was preserved." The fungus committee realized that fungi in some groups cannot be typified by actual preserved herbarium specimens and that hence a figure and/or a description must continue to suffice in lieu of actual material. The proposal was rejected.

Another proposal provided as an addition to Article 23 that "For purposes of homonymy only, valid publication of names of genera in all groups of plants begins with May 1, 1753". This addition would have nullified in large measure the present starting-point dates for the fungi. The proposal was rejected.

French mycologists had proposed that the starting point date for "Fungi caeteri", now established as Jan. 1, 1821, et seq. (Fries, Systema Mycologicum) be changed to the Epicrisis of Fries, 1836, or that the date of publication of volume one of the Systema be arbitrarily established as Dec. 31, 1821. Either of these proposals would have necessitated extensive changes in fungus binomials. The proposal was rejected by the Nomenclature Section on the recommendation of the special committee for fungi.

A proposal by certain American Mycologists to establish Persoon's Synopsis Methodica Fungorum, 1801, as the starting-point date for all fungi was withdrawn.

Article 76 of the present Code provides "For nomenclatural purposes names given to lichens shall be considered as applying to their fungal components..." Ciferri and Tomaselli of Italy, with concurrence from several other lichenologists, have decided that the names now given to lichens should apply only to the organisms as a whole and that new names should be given to the fungal components, as is more or less the case with the algal components. They have published many such new names in their work to date in this field. Several proposals to legalize this third name for all lichens were rejected upon recommendation from the fungus committee acting with the lichen committee.

A new Division (III) will be added, outlining for the first time and in some detail provisions for modification and amendment of the Code. It will specify the officers of the nomenclature section, authorize appointment of the special committees for the fungi and other plant groups, and designate procedures for conducting the mail vote and the final and binding vote. Qualifications for voting by individuals and institutions will be established. A proposal that no changes in the code be permitted for the next ten years was rejected.

Final approval was given to the action of the fungus committee in proposing to conserve certain additional fungus genera, including Aschersonia, Candida, Phoma, Urocystis, and Tricholoma. (For a complete list see Mycologia 45: 312-322, 476. 1953.) Other genera such as Oidium and Mycosphaerella are referred to the committee for study. A motion to close the lists for conserved generic names was defeated.

An entire session was devoted to a thorough discussion of the proposed new principle of "rejected names" (nomina specifica rejicienda) which had been offered by the British Botanists and Horticulturists. This was a plan to meet the problem which has arisen through the persistent and ill-advised habit of some taxonomists in resurrecting old and previously practically unused binomials for common economic plants. Plant pathologists, agronomists, plant breeders, and technical workers in general who must constantly use such names, disapprove strongly of this name changing and there has been bitter criticism of a Code which permitted such practices. The adoption of the principle of "rejected names" would have provided machinery for the legal discard of such names. However, it was clear that each such case would require more delving into old literature than any botanist or group of botanists would agree to undertake and the proposal was defeated.

The Section, realizing the importance of the situation, immediately authorized the appointment of a committee on "stabilization of nomenclature" to devise ways and means of bringing about the desired end. The chairman of the committee is Dr. J. S. L. Gilmour, Director of the Cambridge (England) Botanic Garden and leader of the drive to gain approval for nomina rejicienda. American members of the committee are Reed Rollins, Harvard University; D. D. Keck, New York Botanical Garden; F. R. Fosberg, U. S. Geological Survey; and John A. Stevenson, National Fungus Collections, Beltsville, Maryland. A plan will be drawn up for presentation to the 9th Congress at Montreal in July 1959.

The fungus committee agreed unanimously to recommend to the Section that the generic names Hantzchia and Podocystis, although first used for fungi, be discarded mycologically in favor of the later homonyms in widespread use for diatoms.

The fungus committee, with Donald P. Rogers of the New York Botanical Garden as secretary, was reappointed, and took over the duties as well of the lichen committee which was abolished. This committee is charged with the duty of handling problems in mycological nomenclature which may arise in the interval between Congresses.

NATIONAL FUNGUS COLLECTION

INTERNATIONAL COMMISSION ON PLANT DISEASE LOSSES

Meetings in Paris July 1st & 7th 1954
Report to the chairman of the commission

Prepared by Ernst Gram

Present:	Bitancourt, A. A.	São Paulo	Brazil
	Gram, E.	Lyngby	Denmark
	Ling, L.	Rome	Italy
	Moore, W. C.	Harpenden	England
	Pape, H.	Kiel	Germany
	Stevenson, J. A. (representing Paul R. Miller)	Beltsville, Md.	U. S. A.
	ten Houten, J. G.	Wageningen,	Holland
	Vasudeva, R. S.	New Delhi	India

The chairman, Dr. K. Starr Chester, unable to be present himself, had asked Gram to act as chairman. Gram recalled that our commission, on the initiative of Dr. Frans Verdoorn (Botanical Section of the International Union of Biological Sciences), was organized by Dr. K. Starr Chester and was recognized in December 1951 by the International Union of Biological Sciences. It was only through the International Union that we were in touch with Unesco, from which we could under present conditions expect no special support.

The items mentioned in the following were given preliminary treatment at the meeting on July 1st (Unesco) and the discussion continued at the meeting on July 7th (Museum of Natural History).

1. Chairman. It was decided to ask Dr. K. Starr Chester to continue as chairman.
2. Secretary. The members agreed to look out for a specialist to fill the position of permanent secretary. Some financial help will be needed. Investigations should be made to find out whether any financial support might be obtained from the International Union of Biological Sciences.
3. Insect and Nematode Attacks should not be included in the work of our commission but the International Union of Biological Sciences should be called upon to appoint a commission in order to investigate losses caused by insects, nematodes, and other animals, including stored product pests. At some future date the two commissions may find a joint meeting profitable.
4. Actual Losses. Data on actual losses are necessary for elaboration of methods and should be handed over to our commission. Apart from that the commission should restrict its work to methods.
5. Additional Members. It was felt that the Mediterranean countries ought to be represented. Furthermore Herle (Braunschweig) and Conners and Savile (Canada) were mentioned as workers in our field.
6. Publications. The existing national publications were deemed sufficient for most reports. The Plant Protection Bulletin of the Food and Agriculture Organization is open to matters of international interest. Publication of a handbook at the present time is considered premature.
7. Systems of Estimation. Research methods are in general too elaborate; it is necessary to work out more simple methods; for this full-time specialists are needed.
8. Units. It was considered premature to decide upon one single method. In giving estimates it is essential to indicate the method used. Estimates expressed in terms of money have their value for immediate advisory work but it is recognized that prices are dependent on the harvest and that a national loss may mean an individual gain. Percentages of yield may be based on 1) normal yield of the year or immediately preceeding years, 2) the potential yield for the soil and season as found in control trials.

Status of Loss Appraisal --

Brazil: Losses are reckoned on the basis of control experiments.

Denmark: An asserted "sugar beet sickness" was investigated in the 20's; by means of sliding 10-year averages, based on the detailed harvest dates of the sugar factories, it was proved that through many years there had been a decided tendency towards decreasing yields. This was proved to be due mainly to a decreasing number of roots per acre and a remedy was found in new systems of paying for the work of singling; diseases and nutritional disorders were found to have practically no bearing on this situation.

Germany: Experiments in spraying against Phytophthora infestans have shown remarkable regional differences. As regards attacks of Plasmopara viticola the longer period of incubation as compared with potato late blight facilitates forecasting.

India: In sugar cane mosaic, where natural plant to plant transmission is unimportant, a 100 percent attack will mean no more than a 10 percent loss.

The Netherlands: Dr. ten Houten distributed a paper giving the general survey and special surveys of Phytophthora infestans and of cereal rusts (species, intensity, range). A survey of apple scab has been initiated but is in a resting stage for the moment. Instances of losses were given for several attacks.

United Kingdom: A Disease Assessment Committee gives advice on the questions to be tackled. In the Plant Pathology Laboratory of the Ministry of Agriculture two specialists, one for diseases and one for pests, concentrate on the problem. Keys are worked out to be used for 4-5 annual estimates of numerous fields; in the first year the key is criticized, in the second year it is corrected. After 10 years time intensity curves may be worked out, indicating whether or when control measures should be taken. Twelve keys are available for exchange but are not yet published. The estimation of losses should not replace the general intelligence work.

U. S. A.: Dr. Paul R. Miller, in a letter, expressed his interest in modern methods and equipment for estimation of losses. This is essential for the choosing of research problems. Concentrating on Peronosporaceae (for estimation and forecasting) material is collected on the following: duration, acceleration, intensity, environmental and other factors, disease-free standards, recording methods suitable for statistical analysis (size and distribution of samples), costs and profits from control, economic effect of losses.

Lyngby, September 3rd 1954.
Ernst Gram

PHYTOPATHOLOGICAL PROGRAM AT AAAS BERKELEY MEETING

G1. AMERICAN PHYTOPATHOLOGICAL SOCIETY, PACIFIC DIVISION

TUESDAY MORNING, DEC. 28

9:00 am.; Hilgard Hall, 113; Symposium: Crop Sequence and Plant Disease Control. WILLIAM C. SNYDER, University of California, Berkeley, Presiding.

1. Introduction: WILIAM C. SNYDER, University of California, Berkeley. (10 min.)
2. The Decline of Pines in the Southern States. WILLIAM A CAMPBELL, U. S. Department of Agriculture Forest Service, Athens, Georgia. (Lantern, 20 min.)
3. The Asparagus Decline and Replant Problem. RAYMOND G. GROGAN, University of California, Davis. (Lantern, 15 min.)
4. The Lima Bean Root Rot Problem, JAMES B. KENDRICK, JR., University of California, Riverside. (Lantern, 15 min.)
5. Crop Sequence and Soil Borne Diseases of Strawberry, STEPHEN WILHELM, University of California, Berkeley. (Lantern, 15 min.)
6. The Effects of Crop Sequence on Nematode Populations. HAROLD J. JENSEN, Oregon State College. (Lantern, 30 min.)

7. Crop Rotation and Plant Disease Control. JAMES D. MENZIES, U. S. Department of Agriculture, Prosser, Washington. (Lantern, 30 min.)

TUESDAY AFTERNOON, DEC. 28

1:30 p. m.; Agriculture Hall, 113; Symposium: Physico-Chemical Control of Structural Differentiation in the Fungi. Arranged by RALPH EMERSON, Department of Botany, University of California, Berkeley. Joint session of The Mycological Society of America G4; American Society of Plant Physiologists Western Section, G2; Botanical Society of America Pacific Division, G3; Society of American Bacteriologists Western Branches, N9.

Speakers:	R. M. Page	(on Pilobolus)
	E. C. Cantino	(on Blastocladiella)
	K. B. Raper	(on Dictyostelium)
	J. W. Foster	(on bacterial endospore formation)

TUESDAY EVENING, DEC. 28

6:30 p. m.; Banquet: Place to be announced.

WEDNESDAY MORNING, DEC. 29

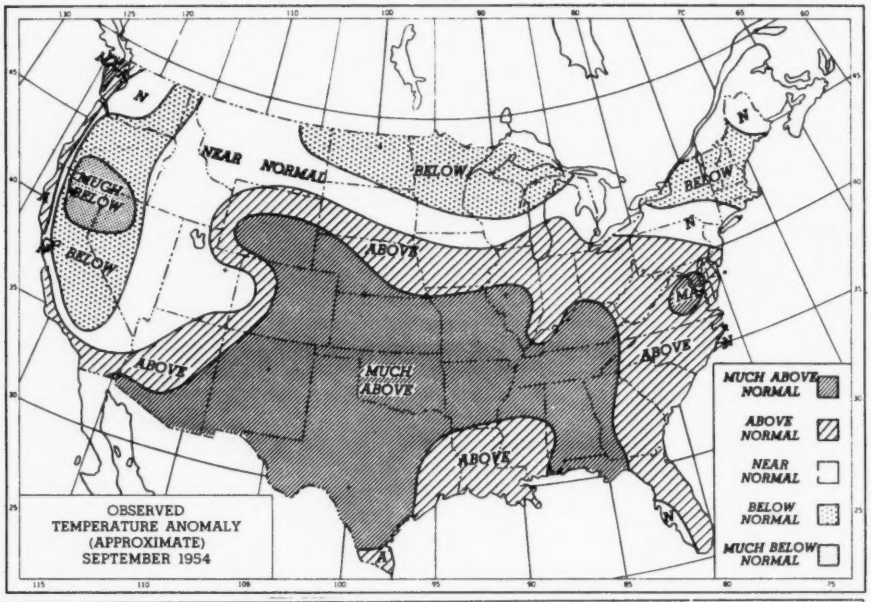
9:00 a. m.; Hilgard Hall, 113; Demonstration of Methods of Assay for Soil Inhibiting Microorganisms. Joint session with The Mycological Society of America, G4. Arranged by ROBERT D. RAABE, University of California, Davis.

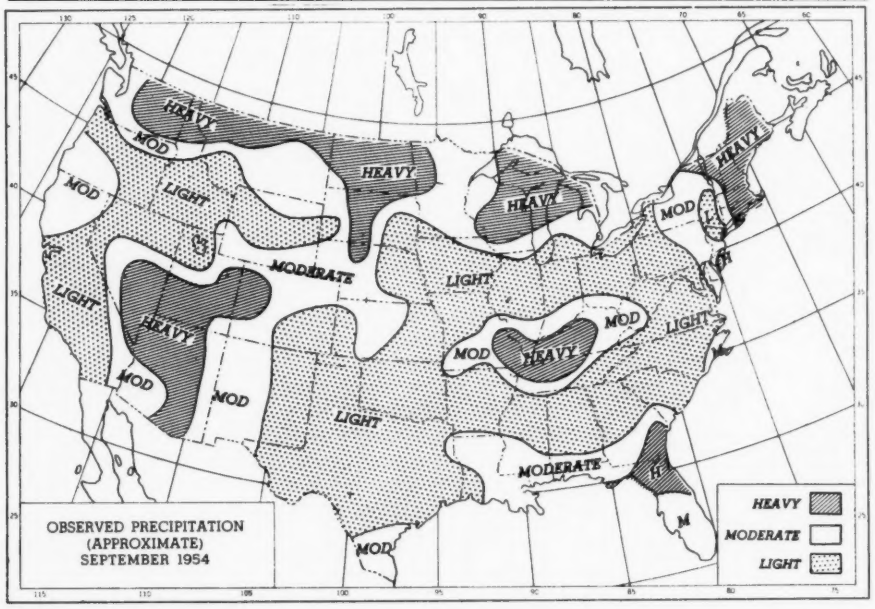
10:30 a. m.; Hilgard Hall, 113; Discussion on Soil Borne Virus Diseases of Plants. Joint session with The Mycological Society of America, G4. BYRON R. HOUSTON, University of California, Davis, Presiding.

WEDNESDAY AFTERNOON, DEC. 29

2:00 p. m.; Agriculture Hall, 113; Symposium: The Mode of Survival of Plant Pathogens in the Soil. Joint session with The Mycological Society of America, G4. JAMES D. MENZIES, U. S. Department of Agriculture, Prosser, Washington, Presiding.

1. The Mode of Survival of Nematodes in the Soil. C. W. McBETH, Shell Development Company, Modesto. (Lantern, 30 min.)
2. The Survival of Phycomycetous Fungi in the Soil. JAMES T. BARRETT, University of California, Berkeley. (Lantern, 30 min.)
3. The Survival of Vascular Pathogens in the Soil. WILLIAM C. SNYDER, University of California, Berkeley. (Lantern, 30 min.)
4. The Role of Sclerotia in the Survival of Fungi in the Soil. LYSLE D. LEACH, University of California, Davis. (Lantern, 30 min.)
5. The Survival of Plant Pathogenic Actinomycetes in the Soil. JOHN W. OSWALD, University of California, Berkeley. (Lantern, 30 min.)





The terms used in the accompanying maps, which define the ranges of temperature and precipitation, are numerical class limits. These are based on a statistical analysis of past records through which is determined the normal frequency of occurrence of temperatures and precipitation at various times of the year for different locations. For temperature the classes above, below, and near normal are so defined that they each normally occur one-fourth of the time; much above and much below normal, one-eighth of the time. Precipitation is depicted in terms of light, moderate, and heavy, each class normally occurring one-third of the time and thereby having equal probability of occurrence. These maps graphically represent only the general trends and give the country's weather picture at a glance. For quantitative studies, where monthly mean temperatures and actual precipitation records are needed for a given time and place, other publications of the Weather Bureau should be consulted. P. R. M.

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